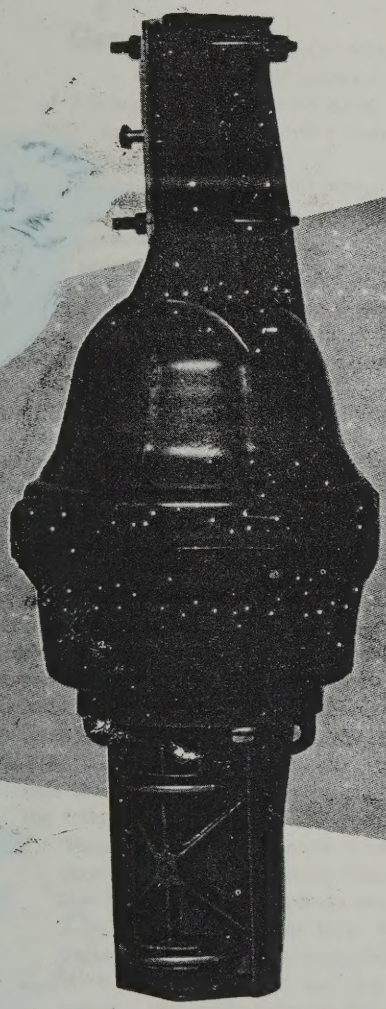
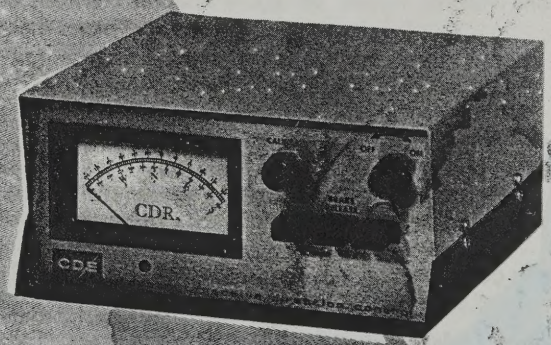
CLASS 252-50

CDE HAM II

ROTOR SYSTEM



Owner's Manual



THE HAM II IS RATED FOR ANTENNAS WITH UP TO 7.5 SQUARE FEET OF WIND SURFACE AREA.

CDE

CORNELL-DUBILIER ELECTRONICS

DIVISION OF FEDERAL PACIFIC ELECTRIC COMPANY

Rotor Department

Fuquay-Varina, North Carolina 27526

OWNER'S MANUAL - HAM II

Foreword

On the following pages, you will find information obtained from the Engineering Staff where the Ham Rotors are built, the Service Engineering Group, and from amateurs who have Ham Rotors installed. No attempt has been made to detail every possible installation or suggest every maintenance procedure that may be necessary to cover many years of operation.

Please feel free to communicate with us at any time that we may be of assistance. Write to:

CORNELL-DUBILIER ELECTRONICS
Division of Federal Pacific Electric Company
CDR Rotor Department
118 E. Jones Street
Fuquay-Varina, North Carolina 27526
919-552-2281

General

The Ham II Rotor System is designed to accomodate amateur antennas with a maximum of 7.5 square feet of wind area. The Ham II provides a full 360° range of rotation and a meter scale read out for accurate position indication.

The Ham II Rotator is built along the general lines of the original CDE Bell type rotors. The motor, radial and thrust bearings, electrically operated wedge brake, gear train, and indicating sensor are built into the elongated bell shaped cast aluminum housing.

The Ham II wedge brake system is operated independent of the clockwise and counterclockwise directional controls. However, the directional controls will not function until the brake is released.

Pre-Installation Check

It is recommended that a preliminary operational check be made on the system prior to actual installation. Check each item of the system for physical damage due to shipping. The Ham II system consists of a control unit, a bell rotator unit, a lower mast support, a hardware package and a service manual. If any of these items are missing or damaged, return the complete system to your dealer or the factory for replacement. Sales receipt must accompany such a return.

After the physical check of the equipment, set up the control unit and the Bell rotator for an electrical check. We recommend the following procedure:

1. Measure out the maximum 8-wire control cable required for your particular installation. (See spec table) strip the insulation from all wires, separate the individual wires back about 2-3 inches, and tightly twist the stranded ends. Soldering these ends improves manageability.
2. With the control unit and the rotator on the work table, connect the cable between the two units. Make sure wires 1, 2, 3, 4, 5, 6, 7, & 8 on the control unit are to 1, 2, 3, 4, 5, 6, 7, & 8 on the rotator, respectively.
   CAUTION: No loose strands of wire should touch adjacent terminals or other metal parts of the units.
3. With the rotator sitting in the upright position and connected to the control unit, by the eight (8) wire cable, plug the control unit power cord into a convenience 115 VAC 50/60 Hz wall socket.
4. Turn the power switch on. The meter should be illuminated.
5. Depress the brake release (center) lever then release it. An audible click should be heard in the rotator. This is the solenoid operating the wedge brake.
6. Depress the brake release, hold, and simultaneously depress the clockwise direction switch (right). The rotator should turn clockwise (looking from top). This is S-W-N-E-S. Release the direction switch; rotator will coast down and stop. Now release the brake. The rotator is now locked into position.

   CAUTION: It is best to release the direction switch, and brake switch prior to end of rotation (extreme clockwise or counterclockwise position) in order not to damage the stop arm and/or the gears.

The rotator is now stopped and the brake is engaged. To turn the rotator counterclockwise, release the brake, hold and simultaneously depress the counterclockwise switch (left). The rotator will turn counterclockwise. This is S-E-N-W-S. After rotator has stopped, release the brake.

Prior to actual installation, check the calibration to familiarize yourself with this procedure. It is best done while the system is still set up for the Pre-installation check.

In Service Operation

The Ham II brake release feature is specifically designed to decrease the effects of torsional forces caused by rapid de-acceleration and instant stopping of large antennas and beams. With practice, smooth and precise stops can be made without overstressing the rotator, tower, antenna or supporting mechanisms. By releasing the direction control switch slightly before the point of intended antenna position, letting the unit coast to a full stop, then releasing the brake, no snap action stops are required. This feature of the Ham II, when properly used, should prolong the life of your rotor system as the major stresses are greatly decreased.

Service

Cornell-Dubilier maintains a modern well staffed repair department for all CDE antenna rotors. If service is required, the unit should be packed securely and sent prepaid to:

Cornell-Dubilier Electronics
Rotor Service Department
118 East Jones Street
Fuquay-Varina, N. C. 27526

For units that are in warranty, no charge will be made for repair. If the unit is out of warranty, the following flat rate charges apply:

Control box only	$ 23.00
Rotator only	25.00
Complete unit	$ 36.00

A check or money order for the amount indicated above should be included. The flat rate charge includes rebuilding the unit and replacing of defective parts. Prices subject to change without notice.

Meter Calibration

Rotators are shipped from the factory stopped in the full counter clockwise (South) position. To calibrate the meter, have the rotator full counter clockwise position, on - off switch "off" and use the zero - center screw to line the needle on the left hand "S" limit. With the on - off switch in the "on" position, push in the calibrate knob. The calibrate knob is a push to calibrate type. (Some models: Push, hold in, calibrate, release. Other models, push, release, calibrate, push again to disengage calibrate circuit.) Locate the needle on the right hand "S" limit. This meter calibration can be performed any time it is desired to check the accuracy. When power is off, the needle will fall to the left hand "S". When power is on, the needle will indicate the antenna position. The zener regulated meter supply will minimize reading variations due to line voltage fluctuations.

Rotor Installation The Ham II rotor is engineered to handle relatively heavy antennas including multi-band arrays having traps at the extreme of the elements. Long and trouble free performance of the system depends on making the installation to properly handle the stresses involved. **CAUTION:** THE ROTATOR IS DESIGNED FOR VERTICAL OPERATION WITH THE BELL SHAPED HOUSING IN THE UP POSITION. Water and other contamination will get into the motor unit if mounted horizontal or up-side-down.

Balanced Weight produces only down-thrust on the rotor. With 98 ball bearings operating in accurately machined races, the rotor is capable of handling as much as a thousand pounds downward pressure in line with the axis of rotation.

Unbalanced Weight creates a bending moment of force which is concentrated on the mast at the point where it is clamped to the top of the rotor. This moment tends to strain the mast at that point and also to bind the ball bearings by creating excessive downward pressure on one side and upward pressure on the other. Such unbalance places additional stresses on the motor and gear train. Unbalanced weight becomes critical as the distance from the antenna boom to the clamping point at the rotor is increased.

Wind Pressure against the boom and elements usually produces a bending force on the mast which causes the same stresses as unbalanced weight. To strengthen the installation to withstand unbalanced weight and wind pressure, the top mast should be as short as possible. In multiple arrays the heaviest sections should be closest to the rotator. In order to distribute the binding stress and prevent fracture of the mast, the HAM rotor includes two long, heavy, specially designed steel clamping plates. These are grooved to grip the mast securely. It is recommended that the mast be reinforced in the area where it is clamped by driving a hardwood dowel of proper size into the end of the mast.

Start-Stop Torsion Torsional or twisting forces must be given special considerations when using the Ham rotor with large antennas and beams. The acceleration of the antenna array is gradual as the motor picks up the load. However, if the brake release switch is not used properly, stopping will be instantaneous, therefore, subjecting the antenna, rotator, and support system to undue strain. To alleviate instantaneous stops, always release the directional switch, CW or CCW, prior to the intended antenna direction, let the unit coast down to a stop, then release the brake. When the brake wedge is engaged into the groove of the outer casting, the top and bottom of the masts are locked rigidly together. It is absolutely essential that all mechanical assemblies making up the antenna array be solidly clamped so that no slipping occurs under heavy stop/start/wind load conditions.

Torsional Guying of Tower Average height, well built towers, properly erected, carrying average antennas, are able to absorb the heavy twisting strain at the moment of stopping. Where the antenna is large or heavy, or the tower is tall or of light weight construction, a torsion bar or sway brace (as shown in Fig. 2 on the next page) should be rigidly attached near the top of the tower. Such an arrangement allows the double guy wires to absorb the shock of stopping, which would otherwise tend only to twist the tower on its base.

Mechanical Description The motor drives a train of stainless steel spur and pinion speed reduction gears which in turn drive the ring gear. The ring gear drives the bell shaped upper mast support, into which the antenna mast is mounted in rigid central alignment.

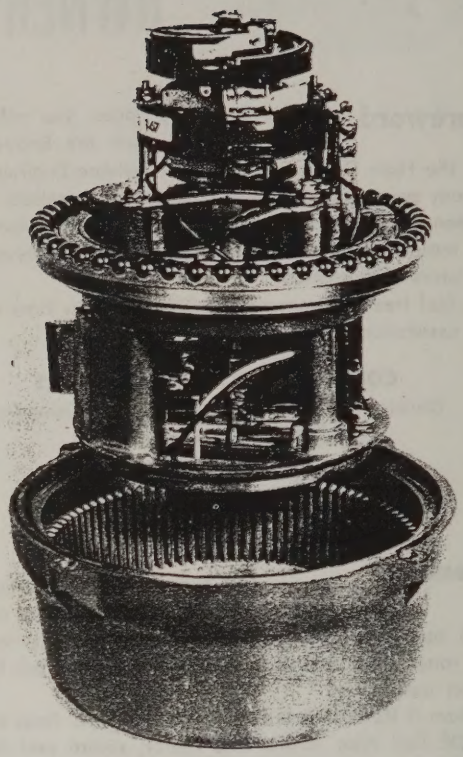


Fig. 1

A boss is cast on the under side and in the center of the cavity of the upper mast support, which engages the serrated edge of the potentiometer arm which is mounted on the top of the inner mechanism.

Maximum support and low frictional loss between the rotating upper mast support and the inner mechanism is assured by the use of two groups of 49 steel balls each riding in the bearing races between the two assemblies, and held in special nylon retainers.

Mechanical stops along with electrical limit switches are built into the rotor mechanism to provide accurate and complete 360 degree rotation.

The brake assembly is released by a 24 volt AC solenoid, the plunger of which is mechanically attached to the wedge. When the wedge is positioned for braking, a cam latch locks the wedge in the teeth of the lower housing. To release the brake, the solenoid is energized. This unlocks the latch automatically and retracts the wedge from the gear teeth in the housing.

Circuit Description Two transformers are mounted in the control unit. The power transformer supplies approximately 30 VAC for releasing the brake and operating the motor when control levers are depressed. Overheating of the transformer from prolonged operation or possible short circuit is prevented by a thermal cut-out switch in the primary winding.

The motor is a two-phase device with the first winding being supplied AC direct from the transformer while the second has a 120-140 MFD. capacitor in series in order to shift the phase and provide forward rotational torque. To reverse, the capacitor is switched in series with the first winding, while the second is directly supplied from the transformer.

The solenoid which releases the brake operates from the same transformer that supplies power to the motor.

The meter transformer is energized as the on-off control is switched to the "on" position. This illuminates the meter dial

and the meter indicates the position of the antenna. 13 VDC is supplied to the 500 OHM potentiometer in the rotator through a zener regulated supply.

The meter is a high quality DC instrument requiring 1 MA for full scale deflection. It is connected with plus side through the 10 K multiplier to the plus side of supply and potentiometer, which is protected by a 1/8 AMP fast blow fuse. The meter circuit is completed through the 5000 OHM calibrate control and operate/calibrate switch to ground. The operate/calibrate control is located on front panel. With the zener controlled supply the 5K calibrate control will be set at approximately 3000 OHMS which will give 13,000 OHMS in series with meter to allow for 1 MA deflection at full scale.

Two electrical limit switches in the rotator cut the motor power just before the rotation reaches the extremes. A fuse, located on rear panel is also included on one side of the AC power line.

CONSTRUCTION NOTES

A. Tape cables securely to mast.
B. Provide slack for rotation and drip loop.
C. Anchor securely to standoff to prevent strain on connectors and slipping of cable.

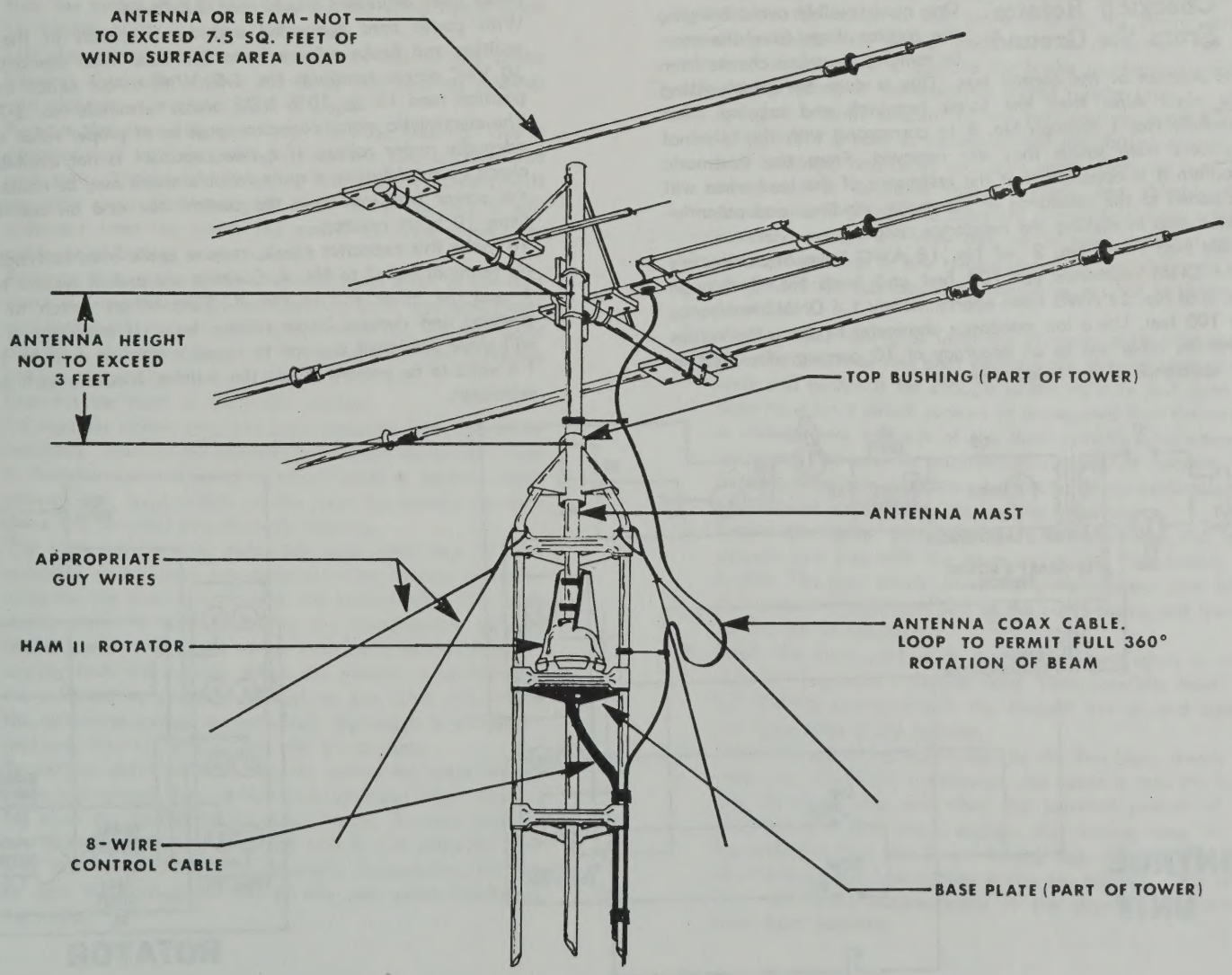


Fig. 2 — INSTALLATION

Checking Control Unit

To check the control unit, plug line cord into 115 volt AC power. With no connections to terminals turn the on-off switch to on position, the meter light will illuminate. Meter needle will remain on left hand "S".

To check the power circuit connect an AC voltmeter between terminals No. 1 and No. 2 on the rear panel and see that approximately 30 volts is indicated when brake release lever is depressed. Connect meter leads between terminals No. 1 and No. 5 and read approximately 30 volts with brake release lever and clockwise lever depressed. Now connect meter leads between terminals No. 1 and No. 6 and read approximately 30 volts with brake release lever and counterclockwise lever depressed.

Checking Rotator

Connect all 8 terminals of the control box to the corresponding 8 terminals of the rotor using the coil of cable obtained for the installation. The 2 heavy wires in the cable should be used for terminals 1 and 2 (Refer to Schematic). CAUTION — SHORTS BETWEEN TERMINALS OR GROUNDED LEADS MAY BURN UP THE POT STRIP IN ROTATOR.

With the rotor in an upright position without the lower mast support assembled, operate rotator by means of control unit lever in both directions. The operation of control unit lever on and off, releases the brake mechanism in rotator. This is audible to the operator.

Checking Rotator From the Ground

One may possibly avoid bringing the rotator down from the mast by making electrical checks from the position of the control box. This is done by disconnecting the eight wires from the screw terminals and tagging them carefully No. 1 through No. 8 to correspond with the terminal numbers from which they are removed. From the schematic diagram it is apparent that the resistance of the lead wires will be added to the resistance of the motor windings and potentiometer strip in making the resistance checks.

Leads No. 1 and No. 2 of No. 18 AWG have approximately 0.64 OHM resistance per 100 feet and leads No. 3 through No. 8 of No. 22 AWG have approximately 1.6 OHMS resistance per 100 feet. Use a low resistance ohmmeter to check the values shown in table one to an accuracy of 10 percent after adding the resistance of the leads involved.

To Check	Read Resistance	Between Terminsl
Brake Solenoid	.75 ohms + leads	1-2
½ Motor Winding	2.5 ohms + leads	1-8
½ Motor Winding	2.5 ohms + leads	1-4
½ Motor + Switch	2.5 ohms + leads	1-5
½ Motor + Switch	2.5 ohms + leads	1-6
Entire Motor	5 ohms + leads	8-4
Right Limit Switch	0 ohms + leads	8-5
Left Limit Switch	0 ohms + leads	4-6
Entire Pot Switch	500 ohms	3-7
Pot Arm to + End	0 to 500 ohms	3-1
Pot Arm to — End	0 to 500 ohms	1-7

Table 1

Servicing the Control Unit

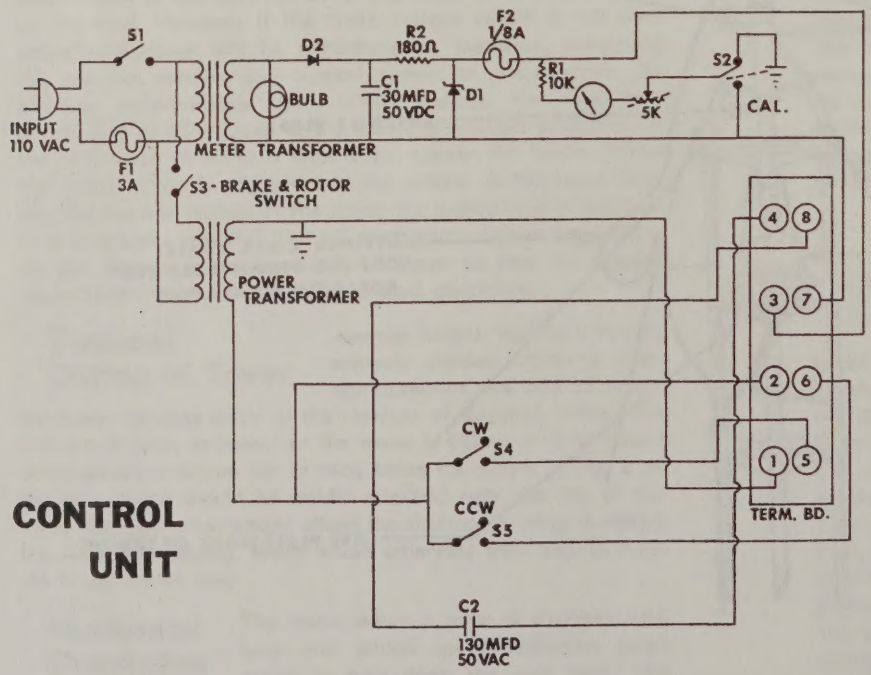
Disconnect the AC power source and remove the eight wire control cable. Be sure to tag each wire with the corresponding terminal number.

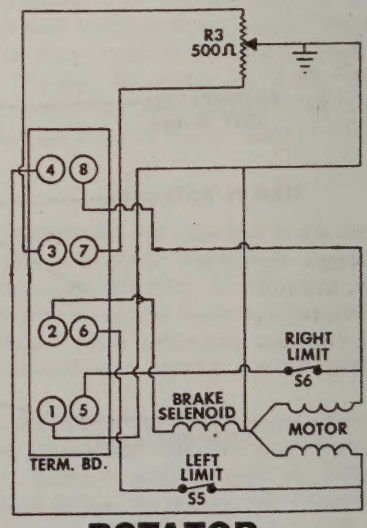
The control box can be checked without removing the cover by using a volt-ohmeter to check values across terminals. Resistance across terminals No. 1-2 should read .4 Ohms. Read same value across terminals No. 1-5 with clockwise switch lever (right-hand) depressed and across terminals No. 1-6 with counter clockwise switch lever (left-hand) depressed. Resistance across input line cord with on-off switch in the "on" position and the brake lever depressed should read 3.8 Ohms.

With power cord connected and on-off switch in the "on" position and brake release lever depressed read approximately 30 VAC across terminals No. 1-2. With on-off switch in "on" position read 13 ± 10% VDC across terminals No. 3-7.

The electrolytic motor capacitor must be of proper value to give adequate motor torque. If a new capacitor is not available for check by substitution, a quite reliable check may be made using the power transformer in the control box and an auxiliary 1 Ohm 10 Watt resistor.

To make this capacitor check, remove cable from terminals and tie terminal No. 2 to No. 4. Connect one end of resistor to No. 1 and the other end to No. 8. Turn off-on switch to "on" position and depress brake release lever. If capacitor is ok it will draw sufficient current to cause a voltage drop of 1.4 to 1.6 volts to be present across the resistor. Measure with an AC voltmeter.





NOTE: USE # 18 WIRES FOR TERMINALS 1 & 2.

Fig 3

Disassembly of Rotator

1. Remove the bottom mast support to permit the rotator to be set on a flat bench.
2. Remove four screws and carefully raise top casting to expose potentiometer and drive mechanism.
3. Carefully remove upper ball retaining ring. Keep it circular, and lay it on clean paper.
4. Inspect inside of top housing for small scratches or burned spots on the ribs. These are an indication that a switch blade or connection is rubbing during rotation. See that the pot strip is clean and not burned at either end. See that pot body is secure and that pot arm is clean at the point of contact. Use only fine rouge cloth to polish contact arm. Check limit switch to see if wires are secure and insulation is undamaged. Contacts should be clean. Check for 1/32" clearence between switch blades and motor—particularly alongside of lockwasher under motor fastening. Greater clearance gets switch too close to top bell housing ribs.
5. If the drive ring happens to be near end of rotation, operate the top spur gear to rotate the mechanical stop on the drive ring away from the area of the limit switch. See that the mechanical stop lever (which is positoned between the two limit switches) will open each electrical contact before it hits the corresponding mechanical stop. Also see that the stop lever has not been deformed and that the electrical contacts are clean and uncorroded.
6. Rotate the top spur gear several revolutions to determine that the motor and its bearings are operating freely. Look for broken teeth in any of the gears.
7. Lift the motor and brake mechanism out of the brake housing. Carefully remove the lower ball bearing retainer and place it on a clean piece of paper.
8. Remove the drive ring gear from the base housing. This is accomplished by first pulling up on the side opposite the gear train. Then raise the entire ring slightly upward with the side away from the gear train higher so that it will slide out from the under the gears. Examine closely for evidence of broken or worn teeth.
9. Examine the inside of the screw terminal strip to see that there is proper clearance between the solid lugs and frame and that there are no faults in the insulation. Pay particular attention to the insulation at the point where the wires are held in metal clips.
10. Examine the teeth in the brake casting.
11. To separate motor, pot, and gear assembly from the brake assembly, unsolder the solenoid leads from terminals 1 and 2. Remove screws holding terminal board to casting. Then remove four large screws in the base. Be careful to clear wires and terminal strip through opening.
12. The latch mechanism, accessible only after step 11 disassembly, slides down into grooves in the casting and provides the top bearing surface for the brake wedge. The latch itself, which is held down by the compression springs, should prevent the brake wedge from being pushed into the casting from the outside. When the plunger is pushed into the solenoid by pressure applied on the latch pin, where the retracting springs are attached, the wedge is withdrawn and may then be pushed clear into the casting.
13. To remove potentiometer, pry the spring fasteners with a sharp instrument. Remove hex nuts. Unsolder leads. Mounting studs are welded to the motor frame. Be sure that the pot strip is clean and that pot arm is not corroded. Use only fine rouge cloth as an abrasive. In replacing the pot be sure the connections are on the side which overhangs the motor.
14. To replace the motor, first remove the pot per Paragraph 13, then unsolder black motor lead from screw terminal 1, the red lead from inside left limit switch lug, and the blue lead from inside right limit switch lug. Fastenings holding motor on studs may then be removed and the motor pulled up and out. In replacing a motor, be sure to see that the round hole in the motor is next to the limit switch. Use a double lock nut on this stud near the limit switch, to provide clearance with the leads. Use special internal-external lockwasher over the stud that works in the slotted hole in the motor. Be sure that the pinion is snug against the spur gear before tightening this fastening over the slot.
15. When it is necessary to closely inspect or replace gears, it is possible to remove motor, limit switch, pot, and terminal strip without unsoldering more than the solenoid leads from terminals 1 and 2. Remove motor fastenings from the mounting studs. Work motor up and out, exercising care in pulling leads and terminal strip through the window in the gear housing. Remove plate to expose gears. Carefully note positions for proper replacement.

Final Reassembly of Rotator

It is assumed in the following instructions that the brake mechanism is assembled and operative. The motor and gear train along with potentiometer and limit switch are likewise assembled and wired and operative.

It is not likely that the brake wedge will be exactly positioned in relation to the teeth in the brake housing to permit proper assembly unless the brake mechanism is retracted. For this reason it is necessary to operate the brake mechanism electrically during step 8 of the assembly of the rotator unit.

1. See that a small amount of low temperature, high quality, light weight grease is conservatively distributed around the ball bearings, ring gear, and spur gears. Only an even film of grease is desirable (approximately one thimbleful of grease should be used to lubricate a completely dry rotator). Excessive grease will only run out in high temperatures or cause power loss in low temperatures. A few drops of light weight No. 10 lubricating oil should be applied to the motor bearings.
2. Rotate upper spur gear until the inwardly protruding mechanical stop on the ring gear engages the channel shaped stop lever and pushes it far enough to the right to just open the right hand limit switch contact (it is assumed that the rotator is viewed from the side of the limit switch). This situation represents the extreme counterclockwise end of rotation. The potentiometer arm must then be rotated to its extreme counterclockwise position against the top brass stop.
3. Secure the upper bell housing upside down by the mast support in a vise with the open end of the "V" toward the bench. The boss which drives the potentiometer arm which is located in the bottom part of the ball housing will then be to the left of center.
4. Clean the inner portion of the housing and apply a small amount of grease to the ball race. Then carefully insert one ball bearing assembly with the flanged rim up and against the outer edge of the casting.
5. Grasp the operating mechanism by the flat base, steady the ring gear, invert the mechanism and lower it into the housing. In doing this, note that the serrated portion of the potentiometer arm must engage the driving boss in the housing and that the three driving lugs on the ring gear must engage the mating lugs in the top housing. This situation will result automatically if the previous instructions have been followed.

6. Determine that the top bearing surface is clean and apply a film of grease on the top ball race and the top bearing assembly. Then apply the top bearing assembly to the race with the rim downward.
7. Clean the brake housing and apply a light film of grease to the ball race only. Lower the brake housing into place so that the assembly holes will approximately line up with the threaded holes in the upper housing. DO NOT MECHANICALLY FORCE AN EXACT ALIGNMENT OF THESE HOLES WITHOUT ELECTRICALLY RELEASING THE BRAKE MECHANISM.
8. Connect the control terminals No. 1 and No. 2 only to the corresponding terminals on the rotator while it remains clamped in the vise. Momentarily operate the lever on the control box to retract the brake. This will permit the brake housing to be freely rotated for exact alignment of the holes. With the power applied to the brake, insert the 4 assembly screws and run them down to a reasonably tight position. Keep the brake retracted electrically while all 4 screws are being tightened. Release the brake electrically and use a heavy screwdriver with wrench to completely tighten the 4 assembly screws. Torque to 85 inch pounds.
9. It is suggested that all 8 wires be connected from the control box while the rotor is still on the bench and that its complete operation be checked.

TROUBLE SHOOTING SUGGESTIONS

Field experience has shown that most operational difficulties with the HAM rotor are traceable to broken, shorted, or grounded wires—usually at the terminal strips. Time spent in cutting the leads to exact lengths, tinning, forming, and wrapping around terminals, cutting insulation to exact length, and clamping to prevent strain on any single wire, will pay big dividends later in long and trouble-free performance. Put it up right—and leave it up!

Should trouble occur, first follow the suggestion on Page 5 for "Service Control Unit" and "Checking Rotor From Ground". Compare resistance values with Schematic Diagram to localize trouble. The following "symptoms" and "treatments" may also be helpful.

Mechanical Play To prevent binding under adverse operating conditions, a small amount of play is designed into the rotor. Even a degree or so of rotary play will permit several inches movement at the end of a wide antenna boom, or at the tips of the elements. Frequently the slight motion of the antenna array in gusts of wind is due more to the natural flexing of the elements and masts than it is due to actual play in the rotor mechanism.

Antenna Rotates in Heavy Wind This is usually a matter of the mast slipping in the support. For large arrays it is often necessary to drill a ⅜" hole through clamping plate, mast and mast supports and pin them together with a non-corrosive fastening. A false indication of suspected "slipping" can be obtained by comparing meter readings at different times when the beam has not been "rotated officially". If the rotor is actually turning, the brake latch is not engaging properly. Since it is pulled into place by springs and only retracted electrically, it will be necessary to disassemble the rotor per instructions on page 6 and follow suggestions of step 12 regarding the latch mechanism.

Lack of Power so that antenna rotation is slow or sluggish. Be sure that the heavy leads in the cable were used for Terminals No. 1 and No. 2, as these leads must carry about 5 amps. to handle power for both the brake and motor. Use method on page 5 to check motor from ground. Check the capacitor. Check transformer for AC output. If the electrical circuit is OK, then check for mechanical binding. Pay particular attention to bearings and alignment of shaft on an inside tower mount. As a last resort, dismantle the rotor to check gears, bearings, etc.

No Meter Indication The brake and motor operate independent of the indicating system. If the pilot lights burn at proper brilliancy, the instrument transformer is OK and output is not shorted. Check for about 21 VDC across terminals No. 3 and No. 7 with switch operated. If this is present, check for 500 ohms across these leads to rotor (disconnected at control box). If 500 ohms is present from No. 3 and No. 7, see if the readings from No. 3 to ground and No. 7 to ground total 500 ohms. If this is so, connect an auxiliary meter from terminal No. 3 to ground and see that voltage runs from zero to about 12 volts as antenna is rotated from left to right extremes.

No Rotation — Indication OK Either the thermal cutout in the power transformer has opened to protect the motor or capacitor from excessive heat of prolonged operation or there is actually trouble on the motor circuit. After allowing time for the thermal cutout to restore service, proceed with suggestions above for "lack of power".

Grounded Leads Grounds on cable leads will burn out either the line fuses or the small fuse in the DC circuit. For full explanations, refer to Schematic. If lead No. 3 is grounded, it shorts out part of the pot, so that as rotation progresses to the other end, the full DC voltage is applied across a decreasing portion until current becomes so high that it burns out. Note also that any grounds either put an overload on the power transformer which causes the line fuse to blow, or overload the rectifier circuit so that the ⅛ amp fuse blows.

Meter Fluctuation An intermittent condition in any component in the rectifier or meter circuits within the control box, as well as in the cable or potentiometer circuit in the rotator itself can cause meter fluctuation or error. Possible causes of such trouble may be localized by placing a test DC meter across terminals No. 3 and No. 7 and comparing the action of the test meter with the panel meter.

If the test meter fluctuates along with the panel meter, either a component in the rectifier circuit is intermittently defective, or an intermittent trouble-ground is drawing excessive current. To further localize such a condition, leave the test meter on terminals No. 3-No. 7 and remove the corresponding leads to the rotator. This removes the load from the DC circuit so the test meter will show about 12 volts. The panel meter sensitivity will be cut about in half, so it will show about ¾ scale. Fluctuation of the test panel meters will now point to trouble in the DC rectifier circuit. Fluctuation of panel meter only, will point to intermittent trouble in the meter, multiplier resistors, or the "cal." pot.

Where the meters are steady in preceding tests, and there is fluctuation with rotator leads connected, it indicates trouble in the lead wires or rotator itself. The resultant fluctuations usually cause the meter to pulse UPWARD from a given reading. Any dirt, grease or corrosion that breaks or interferes with the ground return from the potentiometer slide will cause the needle to fluctuate from a true reading toward a center scale point. In such cases it is necessary to open the rotator per instructions on page six.

The ground connection is carried through the potentiometer pivot directly to the frame.

PARTS AND PRICE LIST

CONTROL UNIT
HAM - II/CD-44

50940-10 PART NUMBER	Control Unit, Complete (115 VAC) DESCRIPTION	Quantity	$89.95 Price Each
	ELECTRICAL		
10344-03	Fuse, 3 Amp, F-1	1	.30
10733-01*	Transformer, Power 115 VAC-Std on 50940-00	1	14.50
30112-05	Switch, Micro S-3, S-4, & S-5	3	1.60
51172-00	Capacitor (120-140 Mfd.) C-2	1	2.50
50153-00	Diode, Zener, D-1	1	4.50
50177-00*	Transformer, Meter 115 VAC-Std. on 50940-00	1	7.00
50183-00	Capacitor (30 MFD) C-1	1	1.30
50501-00	Diode, 100 Piv. D-2	1	1.00
50513-11	Resistor (10K Ohms 1/2W) R-1	1	.35
50513-12	Resistor (180 Ohms 1W) R-2	1	.35
50563-00	Fuse, 1/8 Amp., F-2	1	.30
50861-00	Line Cord, 3 Wire	1	2.00
50883-00	Meter, Lamp Holder, and Bezel ("N" Center)	1	23.10
50895-00	Bulb, Meter	1	.90
50899-00	Switch, On-Off, S-1	1	2.00
50900-00	Switch, Calibration, S-2	1	5.60
	SHEET METAL AND HARDWARE		
10555-00	Strip, Solder Terminal	1	.50
10563-00	Holder, Fuse, F-1	1	1.90
30362-05	Spring, Extension (Meter Bezel)	2	.30
50185-00	Holder, Fuse, F-2	1	.60
50187-00	Knob, Switch	2	1.00
50194-00	Clamp, Cable	1	.20
50300-00	Bumper, Rubber	4	.15
50399-00	Strip, Terminal (8 Pin)	1	.70
50884-00	Lever, Switch (Direction & Brake)	3	.60
50885-00	Cover, Top (Tan)	1	4.00
50886-00	Cover, Bottom (Brown)	1	4.50
50890-00	Face Plate	1	3.10
50891-00	Chassis	1	6.00

*Note: 115 VAC control unit can be converted to 220 VAC by installation of the 220 VAC power and meter transformers.

10735 - 01 Transformer, Power, 220 VAC
50202 - 00 Transformer, Meter, 220 VAC

To order parts, remit check or money order for total parts cost plus $1.00 for postage and handling to: Cornell-Dubilier Electronics, Department "C", 118 E. Jones Street, Fuquay - Varina, N. C. 27526

Prices subject to change without notice. CDE reserves the right to change prices at its option. Current prices may be obtained by calling or writing the factory. Please send self addressed stamped envelope.

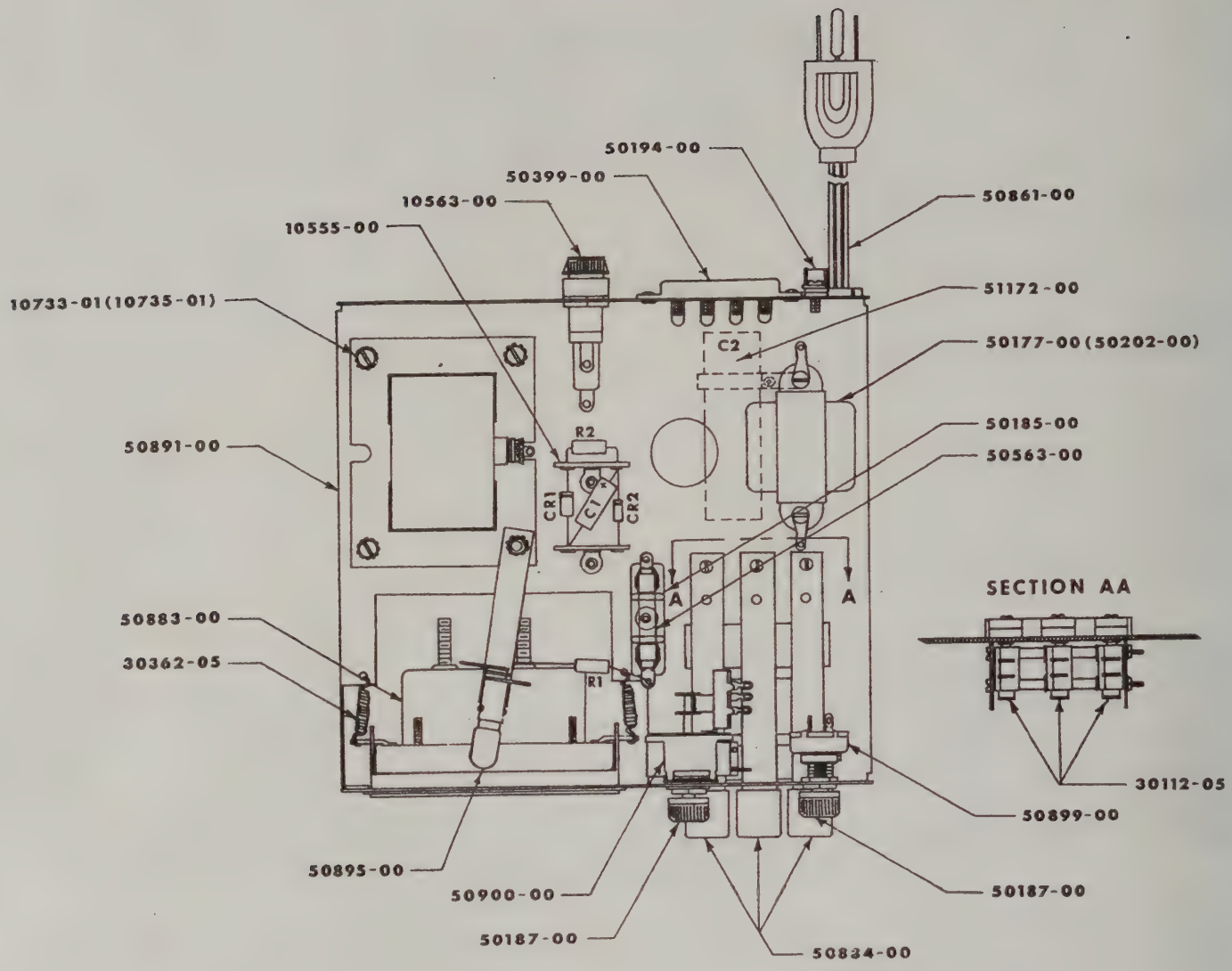


Fig. 4

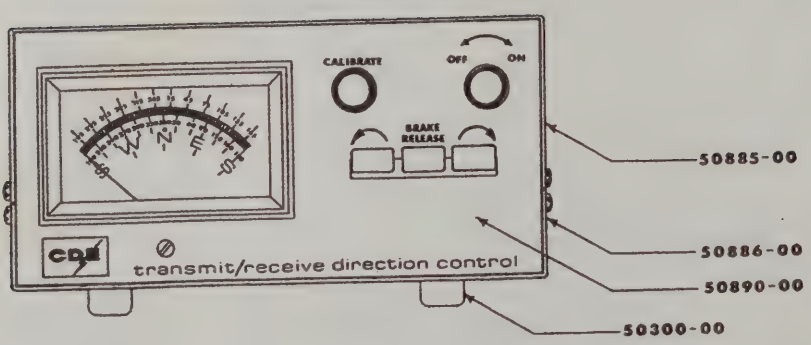


Fig. 5

LIMITED WARRANTY

CORNELL-DUBILIER ELECTRIC CORPORATION (CDE) warrants that your new ROTOR has been manufactured free of defects in design, material and workmanship. If this product fails to give satisfactory service due to defects covered by warranty, including any warranty implied by law such as WARRANTIES OF MERCHANTABILITY OR FITNESS, for a period of ONE YEAR FROM THE DATE OF PURCHASE, CDE will, at its option, replace or repair the unit, or any defective part free of charge.

To obtain warranty service, return the ROTOR to your dealer, or pack it securely, and send it with proof of purchase date and a letter explaining the problem, shipping cost prepaid, to: CORNELL-DUBILIER ELECTRIC CORPORATION, WARRANTY REPAIR DEPARTMENT, 118 E. JONES ST., FUQUAY-VARINA, N.C. 27526.

IMPORTANT

Warranty service covers repair or replacement of the ROTOR only. CDE is not responsible for costs of removal or reinstallation, or shipping to the place of repair. The warranty period is not extended due to repair or replacement. CDE reserves the right to make reasonable charges for service if there is evidence of damage due to alteration, misuse or installation not according to the enclosed instructions.

CDE IS NOT RESPONSIBLE FOR DAMAGE TO OTHER EQUIPMENT OR PROPERTY OR FOR ANY OTHER CONSEQUENTIAL OR INCIDENTAL DAMAGES OF ANY KIND, WHETHER BASED ON CONTRACT, NEGLIGENCE OR STRICT LIABILITY. MAXIMUM LIABILITY SHALL NOT, IN ANY CASE, EXCEED THE PURCHASE PRICE OF THE UNIT.

(Some states do not allow limitations on how long an implied warranty lasts, or the exclusion or limitation of incidental or consequential damages, so the above limitations and exclusion may not apply to you.)

(This warranty gives you specific legal rights. You may also have other rights which may vary from state to state.)

PARTS AND PRICE LIST

HAM-II ROTATOR

PART NO.	DESCRIPTION	QUANTITY	PRICE EACH
50232-00	Rotator Unit Complete	1	$83.95
50349-01	Lower Mast Support Assy.	1	5.00
50339-00	Terminal Cover Plate for Lower Mast	1	.50
50155-00	Grommet for Terminal Cover	1	.18
50304--01	Upper Mast Support (Bell Casting)	1	7.50
50095-00	Brake Housing (Lower Casting)	1	8.00
50335-01	Ball Bearings	98	.12
50113-00	Ball Retainers	2	1.10
50097-00	Brake Support Casting	1	6.25
50370-00	Base Casting & Gear Shaft Assy.	1	5.10
50310-00	Motor Pinion (Nylon)	1	.50
50112-00	Gear and Pinion (1st, 2nd, and 3rd from Motor)	3	4.50
50111-00	Gear and Pinion (Thick pinion 4th from Motor)	1	5.25
50107-00	Final Spur Gear	2	2.40
50313-00	Ring Gear (Cast Aluminum)	1	2.50
50341-00	Small Gear Spacer (Brass)	1	.30
50378-00	Large Gear Spacer (Steel)	1	.40
50379-00	Bushing for Final Spur Gear	1	.40
50460-00	Motor & Pinion Assy.	1	18.10
50122-00	Motor Mounting Plate with Studs	1	2.50
50231-00	Potentiometer Assembly (Complete)	1	9.60
50090-00	End of Rotation Switch Assembly (Complete)	1	3.30
50338-00	Stop Lever Assembly	1	1.00
50099-00	Solenoid Only	1	9.10
50100-00	Solenoid Pin	1	.40
50101-00	Solenoid Pin Spacers	3	.30
50282-06	Solenoid Pin RetainingRing	2	.15
50114-00	Solenoid Retracting Springs	2	.25
50096-00	Retracting Spring Clip	2	.15
50103-00	Brake Wedge	1	4.40
50098-00	Connecting Links	2	.50
50102-00	Connecting Link Pin	1	.35
50117-00	Brake Wedge Support	1	.95
50104-00	Brake Latch	1	1.00
50106-00	Latch Pins	2	.25
50282-04	Latch Pin Retainers	2	.15
50105-00	Latch Springs	2	.25
50399-00	Terminal Board Assembly (8 Terminals)	1	.70
51234-00	Retainer for Stop Lever Assembly	3	.15
51120-00	Washers	3	.10
02-06006-061	Self-Tap Screw 6-32x⅜	2	.10
51057-00	Hex Hd. Screw (Taptite) 12-24x¾	4	.15
50463-00	Mounting Kit	1	6.00
	(2) 50115-00 Mast Clamp		
	(4) 50382-00 "U" Type Bolt (Stn. Stl.)		
	(4) 50502-00 Spacer		
	(6) Screw, Hex Hd. ¼-20 x1¼		
	(10) Hex Nut ¼-20 (Stn. Stl.)		
	(14) Lockwasher, Split ¼"		

To order parts, remit check or money order for total parts cost plus $1.00 for postage and handling to: Cornell-Dubilier Electronics, Department "C", 118 E. Jones Street, Fuquay - Varina, N. C. 27526

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Fig. 6

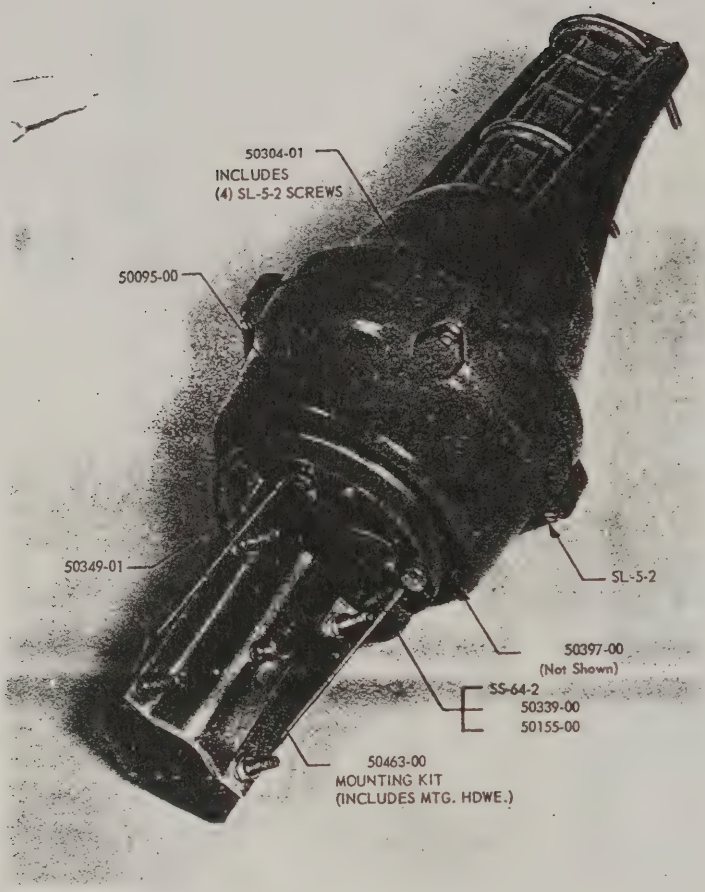
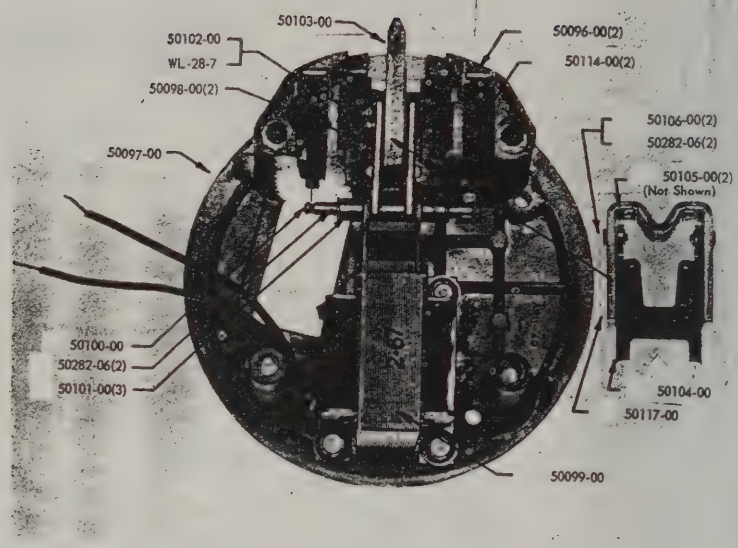


Fig. 8



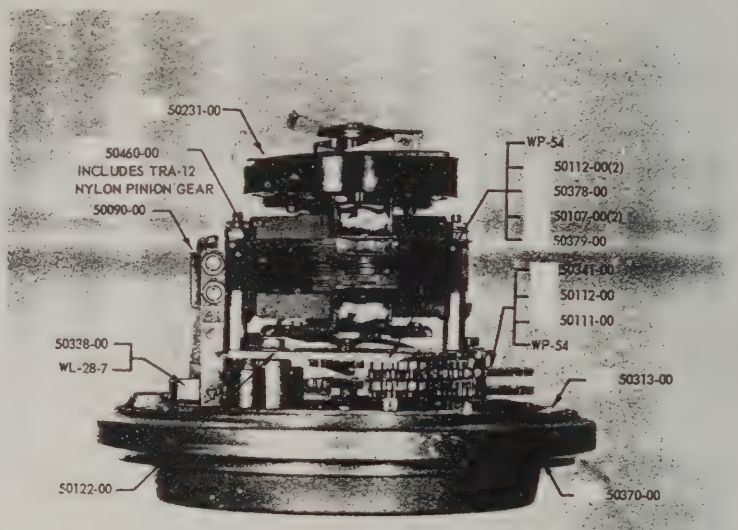


Fig. 7

ACCESSORY KITS

ALTERNATE METER SCALE

50924 - 10 South Center Meter Scale Kit 3.00

SOUTH CENTER SCALE KIT

The stock Ham II/CD-44 control unit is produced with a North Centered meterscale. Since some locations and/or popular working areas may favor rotation stops at North, we provide a South Centered meter scale kit for field modification.

INSIDE TOWER MOUNTS

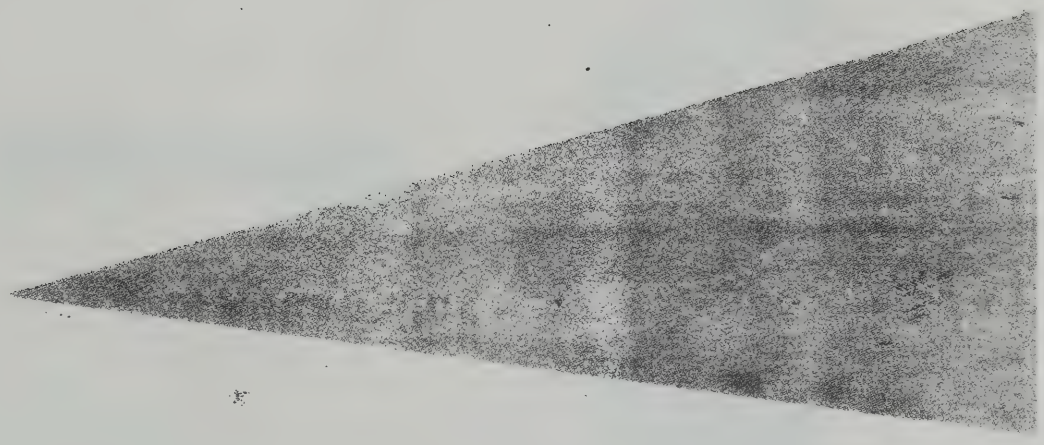
50559 - 10 Tower Spacing Plate Kit 4.50

The tower mounting plate kit is a flat plate equipped with four .5 inch standoff bushings drilled to match the hold down screw holes in the bottom of a CDE Bell type rotator. The plate essentially is designed to allow enough clearance under the bottom of the rotator to permit the rotator to turn without touching the 8-wire control cable.

On any inside tower installation, care must be exercised to get the top mast shimmed to the exact rotational center of the rotator upper mast support. The geometry is such that a mast of 52 mm (2.062 inches) will be exactly centered. For each 1.6 mm(.0625 inches) less mast diameter used, .8 mm (.031 inches) of shim must be wrapped around the mast at the clamping points.

HAM II SPECIFICATIONS

- Input Voltage: 115 VAC 50-60 HZ
  Optional: 220 VAC 50-60 HZ
- Motor: 24 VAC, 2.25 Amp, Split Phase
- Power transformer: 115/26 VAC, 10% duty, thermal protected.
  Optional: 220/26 VAC
- Meter transformer: 115/23 VAC, continuous duty.
  Optional: 220/23 VAC.
- Meter: D.C. voltmeter 1000 ohms/volt
- Meter scale: Direct reading, North centered. 5° increments.
  Optional: South Centered.
- Recommended cable: Belden 8448 or equivalent for up to 45 meters (150 feet).
  Two wires No. 18, 6 wires No. 22.
- Maximum Cable Resistance: Not over 1 ohm for conductors 1 and 2. Not over 2.5 ohms for conductors 3 through 8.
- Rotation time: 45-60 seconds with 60 HZ input.
- Brake: Positive, electrically operated wedge. 96 segments spaced 3° 45′ apart.
- Rotator size: 20 cm (8″) maximum diameter by 50 cm (20″) high with lower mast support. Without lower mast support, 34 cm (13.5″) high.
- Permissable mast size: From 35 mm (1.37″) to 52 mm (2.062″).
- Control box size: 20.5 cm (8.125) wide x 21 cm (8.25″) deep x 10.5 cm (4.125″) high.
- Mounting hardware: Stainless steel.
- Shipping cubature: 37,350 cucms (2280 cu. in.).
- Shipping weight: 13.15 kg (29 pounds).

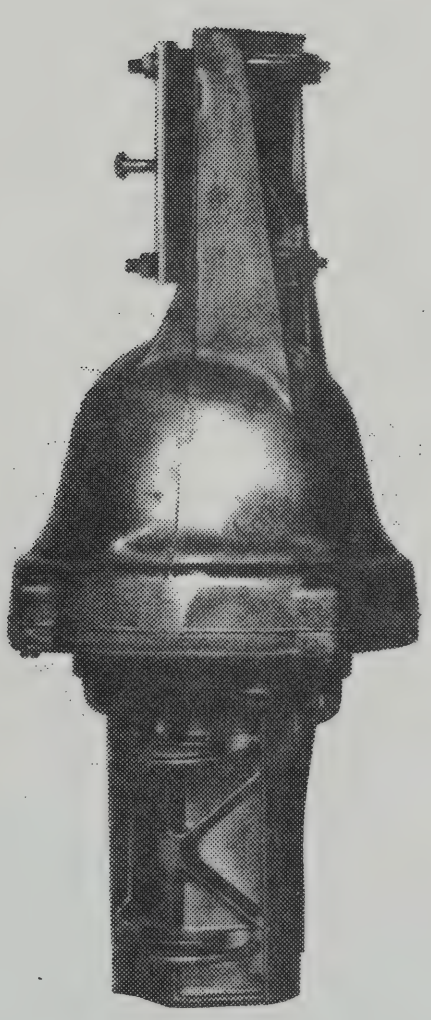


CDE HAM II ROTOR

CLASS 252-45

CDE CD-44

ROTOR SYSTEM



OWNER'S MANUAL

CORNELL-DUBILIER HAM II ROTATOR IS RECOMMENDED FOR ANTENNA ARRAYS LARGER THAN 2.5 SQUARE FEET OF EXPOSED FACE AREA.

CDE

CORNELL-DUBILIER ELECTRONICS

DIVISION OF FEDERAL PACIFIC ELECTRIC COMPANY

Rotor Department

Fuquay-Varina, North Carolina

Foreword

On the following pages, you will find information obtained from the Engineering Staff where the CDR Rotors are built or the Rotor Engineering Group. No attempt has been made to detail every possible installation or suggest every maintenance procedure that may be necessary to cover many years of operation.
Please feel free to communicate with us at any time that we may be of assistance. Write to:

CORNELL-DUBILIER ELECTRONICS
Division of Federal Pacific Electric Company
CDR Rotor Department
Fuquay-Varina, North Carolina 27526
Telephone: 919-552-2281

General

The CD-44 rotor system is designed to accommodate light amateur and C.B. antennas with a maximum of 2.5 square feet of wind area. The CD-44 provides a full 360° range of rotation and a meter scale read out for accurate position indication.

The CD-44 is built along the general lines of the original CDE bell type rotator. The weight of the upper mast and the antenna is carried directly in line with the lower supporting mast. The motor, radial and thrust bearings, armature/disc brake, gear train, and indicating sensor are built into the elongated bell shaped cast aluminum housing.

The CD-44 brake is a disc type built into the bottom portion of the motor armature. With the motor at rest, no power applied, the disc brake is engaged by virtue of the weight of the motor armature. When power is applied to the motor, the armature lifts approximately .80 mm (.031") and releases the disc brake.

Terminal 2 on the control unit is not required when used with the CD-44 rotator. This terminal is for the brake solenoid when the control is used with a Ham-II rotator. However, we suggest attaching the #2 control wire to this terminal in order not to leave a loose wire which could short to another terminal.

Control Unit Versatility

The Ham-II/CD-44 control unit is designed for operation with the Ham-II rotator, part number 50232-00, or the CD-44 rotator, part number 50241-00. If your system demands a larger antenna at a later date, the CD-44 system can be changed to a Ham-II system simply by replacing the rotator unit. The Ham-II rotator unit, less hardware and lower mast support, is priced at $82.95 and may be obtained from a dealer or the factory.

The CD-44 rotator will handle antennas with up to 2.5 square feet of wind area. The Ham-II rotator will handle up to 7.5 square feet of wind area and has a positive electrically operated wedge brake.

Repair Service

Cornell-Dubilier maintains a modern well staffed repair department for all CDE antenna rotors. If service is required, the unit should be packed securely and sent prepaid to:

Cornell-Dubilier Electronics
Rotor Service Department
118 East Jones Street
Fuquay-Varina, N. C. 27526

For units that are in warranty, no charge will be made for repair. If the unit is out of warranty, the following flat rate charges apply:

Control box only	$23.00
Rotator only	25.00
Complete unit	36.00

A check or money order for the amount indicated above should be included. The flat rate charge includes rebuilding the unit and replacing all defective parts.

Pre-Installation Check

It is recommended that a preliminary operational check be made on the system prior to actual installation.
Check each item of the system for physical damage due to shipping. The CD-44 system consists of a control unit, a bell rotator unit, a lower mast support, a hardware package and a service manual. If any of these items are missing or damaged, return the complete system to your dealer or the factory for replacement. Sales receipt must accompany such a return.

After the physical check of the equipment, set up the control unit and the Bell rotator for an electrical check. We recommend the following procedure:

1. Measure out the maximum 8-wire control cable required for your particular installation. (See spec. table) Strip the insulation from all wires, separate the individual wires back about 2-3 inches, and tightly twist the stranded ends. Soldering these ends improves manageability.
2. With the control unit and the rotator on the work table, connect the cable between the two units. Make sure wires 1, 2, 3, 4, 5, 6, 7, and 8 on the control unit are to 1, 2, 3, 4, 5, 6, 7, and 8 on the rotator respectively.
   CAUTION: No loose strands of wire should touch adjacent terminals or other metal parts of the units.
3. With the rotator sitting in the upright position and connected to the control unit, by the eight (8) wire cable, plug the control unit power cord into a convenient 115 Vac 50/60 Hz wall socket.
4. Turn the power switch on. The meter should be illuminated.
5. Depress the brake release, hold, and simultaneously depress the clockwise direction switch (right). The rotator should turn clockwise (looking from top). This is S-W-N-E-S. Release the direction switch; rotator will coast down and stop. Now release the brake. The rotator is now locked into position.
   CAUTION: It is best to release the direction switch prior to end of rotation (extreme clockwise or counterclockwise position) in order not to damage the stop arm and/or the gears.

The rotator is now stopped and the brake is engaged. To turn the rotator counterclockwise, release the brake, hold, and simultaneously depress the counterclockwise switch (left). The rotator will turn counterclockwise. This is S-E-N-W-S.

Prior to actual installation, check the calibration to familiarize yourself with this procedure. It is best done while the system is still set up for the Pre-installation check.

Meter Calibration

Rotators are shipped from the factory stopped in the full counter clockwise (South) position. To calibrate the meter, have the rotator full counter clockwise position, on - off switch "off" and use the zero - center screw to line the needle on the left hand "S" limit. With the on - off switch in the "on" position, push in the calibrate knob. The calibrate knob is a push to calibrate type. (Some models: Push, hold in, calibrate, release. Other models, push, release, calibrate, push again to disengage calibrate circuit.) Locate the needle on the right hand "S" limit. This meter calibration can be performed any time it is desired to check the accuracy. When power is off, the needle will fall to the left hand "S". When power is on, the needle will indicate the antenna position. The zener regulated meter supply will minimize reading variations due to line voltage fluctuations.

Rotator Installation

The CD-44 rotor is shipped from the factory at counterclockwise end of rotation south when viewed from top of rotor.

Install rotor as it comes from factory and point beam south in such a manner that when rotator starts rotating clockwise to other end of rotation the lead wires will not foul.

Wire up the rotator and control box and plug in unit. Meter should read south on left side of dial.

1. The center-of-gravity and center of wind load force of the antenna should be as close to the top of the rotor casting as possible. One to three feet is practical with most installations. When the antenna with a boom length exceeding 8 ft. is to be mounted more than 5 ft. above the top of the rotor, use of a heavy duty tower with the rotor mounted inside is mandatory. The antenna support pipe then should be 2 inch O.D. steel with ¼ inch wall, rotating in a ball-thrust bearing at the top of the tower. The rotor should be mounted inside the tower within 4 feet of this bearing to minimize rotating whip in the tubing. All reliable tower manufacturers will be glad to advise the best method for inside mounting with their product. A rugged mount can be made easily with angle iron and "U" bolts that will fit any tower.
2. The CD-44 easily mounts on a pipe or top of tower, but certain precautions must be observed to obtain good service. The rotor can be subjected to tremendous leverage forces. The rotor can be subjected to tremendous leverage forces mounted in this manner, but the thousands of long term successful "top" installations prove its potential feasibility. A careful survey of hundreds of such installations points up several factors. The center-of-gravity and wind loading of the antenna must be centered over the rotor and not more than 12 inches above it if any part of the antenna array is more than 10 feet from the rotor. The reasoning behind this is simple. The ball-thrust bearing races in the base of the CD-44 are just over 6 inches in diameter. 50 lbs. exerted against a 10 ft. lever will place approximately 2,000 lbs. of "pinch" on these bearings. Each additional foot of leverage or pound of force multiplies this value by a high ratio. Extreme care should be used in any very high, top of clear hill installations. Here the wind forces may be applied at odd angles, such as, a severe up-draft that lifts one side of the antenna, multiplying leverage many-fold.
3. Ever effort should be made to eliminate any source of flexure in the mount or antenna. During even moderate breezes, such flexing can set up an oscillating motion that results in thousands of pounds of torque or bending moment. The two degrees of "lost motion" built into every CDE rotor acts as a vibration dampener but can only counteract for moderate swing. After determining proper orientation of rotor and antenna, we suggest that a ⅜" hole be bored through the tapped pilot hole in the upper and lower clamp plates—through the support mast—and out through the "V" casting. Then run a ⅜" stainless steel bolt and nut of the proper length, tighten securely, through the whole assembly. This is the only known method of insuring no slip at these two points.
4. To summarize: Successful operation of the CD-44 with moderate size antennas is assured if a proper mechanical installation commensurate with the total size of the entire system is made. Please do not attempt another "Easy" 10 ft. by attempting to mount an antenna of any size on top of a 1¼ inch "T.V." mast on top of the rotor—you are just going to pick up pieces after the first wind gust! Do provide a good mechanically solid support for the rotor at the height desired for the antenna; then keep the center of gravity of the array close to the top of the rotor. If there is any doubt about a "Top" mount, then invest in a good inside tower installation; it is an excellent investment.

The CD-44 is engineered to handle light amateur and C.B. antennas. Long and trouble free performance of the system depnds on making the installation to properly handle the stresses involved. CAUTION: THE ROTATOR IS DESIGNED FOR VERTICAL OPERATION WITH THE BELL SHAPED HOUSING IN THE UP POSITION. Water and other contamination will get into the motor unit if mounted horizontal or up-side-down.

Unbalanced Weight

creates a bending moment of force which is concentrated on the mast of the point where it is clamped to the top of the rotor. This moment tends to strain the mast at that point and also to bind the ball bearings by creating excessive downward pressure on one side and upward pressure on the other. Such unbalance places additional stresses on the motor and gear train. Unbalanced weight becomes critical as the distance from the antenna boom to the clamping point at the rotor is increased.

Wind Pressure

against the boom and elements usually produces a bending force on the mast which causes the same stresses as unbalanced weight. To strengthen the installation to withstand unbalanced weight and wind pressure, the top mast should be as short as possible. In order to distribute the bending stress and prevent fracture of the mast, the CD-44 rotor includes two long, heavy, specially designed steel clamping plates. These are grooved to grip the mast securely. It is recommended that the mast be reinforced in the area where it is clamped by driving a hardwood dowel of proper size into the end of the mast.

Mechanical Description

The motor drives a train of spur and pinion speed reduction gears which in turn drive the ring gear. The ring gear drives the bell shaped upper mast support, into which the antenna mast is mounted in rigid central alignment.

A boss is cast on the under side and in the center of the cavity of the upper mast support, which engages the serrated edge of the potentiometer arm which is mounted on the top of inner mechanism.

Maximum support and low frictional loss between the rotating upper mast support and the inner mechanism is assured by the use of two groups of 25 steel balls each riding in the bearing races between the two assemblies, and held in special nylon retainers.

Mechanical stops along with electrical limit switches are built into the rotor mechanism to provied accurate and complete 360 degree rotation.

Circuit Description

Two transformers are mounted in the control unit. The power transformer supplies approximately 30 VAC for releasing the brake and operating the motor when control levers are depressed. Overheating of the transformer from prolonged operation or possible short circuit is prevented by a thermal cut-out switch in the primary winding.

The motor is a two-phase device with the first winding being supplied AC direct from the transformer while the second has a 120-140 MFD. capacitor in series in order to shift the phase and provide forward rotational torque. To reverse, the capacitor is switched in series with the first winding, while the second is directly supplied from the transformer.

The meter transformer is energized as the on-off control is switched to the "on" position. This illuminates the meter dial and the meter indicates the position of the antenna. 13 VDC is supplied to the 500 OHM potentiometer in the rotator through a zener regulated supply.

The meter is a high quality DC instrument requiring 1 MA for full scale deflection. It is connected with plus side through the 10 K multiplier to the plus side of supply and potentiometer, which is protected by a ⅛ AMP fast blow fuse. The meter

circuit is completed through the 5000 OHM calibrate control and operate/calibrate switch to ground. The operate/calibrate control is located on front panel. With the zener controlled supply the 5K calibrate control will be set at approximately 3000 OHMS which will give 13,000 OHMS in series with meter to allow for 1 MA deflection at full scale.

Two electrical limit switches in the rotator cut the motor power just before the rotation reaches the extremes. A fuse, located on rear panel is also included on one side of the AC power line.

Servicing the Control Unit

Disconnect the AC power source and remove the eight wire control cable. Be sure to tag each wire with the corresponding terminal number.

The control box can be checked without removing the cover by using a volt-ohmeter to check values across terminals. Resistance across terminals #1-2 should read .4 Ohms. Read same value across terminals #1-5 with clockwise switch lever (right-hand) depressed and across terminals #1-6 with counter-clockwise switch lever (left-hand) depressed. Resistance across input line cord with on-off switch in the "on" position and the brake lever depressed should read 3.8 Ohms.

With power cord connected and on-of switch in the "on" position and brake release lever depressed read approximately 30 VAC across terminals #1-2. With on-off switch in "on" position read 13 + 10% VDC across terminals #3-7.

The electrolytic motor capacitor must be of proper value to give adequate motor torque. If a new capacitor is not available for check by substitution, a quite reliable check may be made using the power transformer in the control box and an auxiliary 1 Ohm 10 Watt resistor.

To make this capacitor check, remove cable from terminals and tie terminal #2 to #4. Connect one end of resistor to #1 and the other end to #8. Turn off-on switch to "on" position and depress brake release lever. If capacitor is OK it will draw sufficient current to cause a voltage drop of 1.4 to 1.6 volts to be present across the resistor. Measure with an AC voltmeter.

Checking the Rotator from the Ground

One may possibly avoid bringing the rotator down from the mast by making electrical checks from the position of the control box. This is done by disconnecting the eight wires from the screw terminals and tagging them carefully #1 through #8 to correspond with the terminal numbers from which they are removed. From the schematic diagram it is apparent that the resistance of the lead wires will be added to the resistance of the motor windings and potentiometer strip in making the resistance checks.

Lead #1 of #18 AWG has approximately 0.64 Ohm resistance per 100 feet and leads #3 through #8 of #22 AWG have approximately 1.6 Ohms resistance per 100 feet. Use a low resistance ohmmeter to check the values shown in the table below to an accuracy of 10 percent after adding the resistance of the leads involved.

To Check	Resistance	Between Terminals
½ Motor Winding	1.5 ohms*	1-8
½ Motor Winding	1.5 ohms*	1-4
½ Motor + Switch	1.5 ohms*	1-5
½ Motor + Switch	1.5 ohms*	1-6
Entire Motor	3.0 ohms*	4-8
Right Limit Switch	0 ohms + leads	8-5
Left Limit Switch	0 ohms + leads	4-6
Entire Pot Strip	500 ohms	3-7
Pot Arm to + End	0 to 500 ohms	1-3
Pot Arm to — End	0 to 500 ohms	1-7

* plus leads

Disassembly of Rotator

1. Remove the bottom mast support to permit the rotator to be set on a flat bench.
2. Remove four screws and carefully raise top casting to expose potentiometer and drive mechanism.
3. Carefully remove upper ball retaining ring. Keep it circular, and lay it on clean paper.
4. Inspect inside of top housing for small scratches or burned spots on the ribs. These are an indication that a switch blade or connection is rubbing during rotation. See that the pot strip is clean and not burned at either end. See that pot body is secure and that pot arm is clean at the point of contact. Use only fine rouge cloth to polish contact arm. Check limit switch to see if wires are secure and insulation is undamaged. Contacts should be clean. Check for 1/32" clearance between switch blades and motor—particularly alongside of lockwasher under motor fastening. Greater clearance gets switch too close to top bell housing ribs.
5. If the drive ring happens to be near end of rotation, operate the top spur gear to rotate the mechanical stop on the drive ring away from the area of the limit switch. See that the mechanical stop lever (which is positioned between the two limit switches) will open each electrical contact before it hits the corresponding mechanical stop. Also see that the stop lever has not been deformed and that the electrical contacts are clear and uncorroded.
6. Rotate the top spur gear several revolutions to determine that the motor and its bearings are operating freely. Look for broken teeth in any of the gears.
7. Remove the drive ring gear from the base housing. This is accomplished by first pulling up on the side opposite the gear train. Then raise the entire ring slightly upward with the side away from the gear train higher so that it will slide out from under the gears. Examine closely for evidence of broken or worn teeth.
8. Examine the inside of the screw terminal strip to see that there is proper clearance between the solid lugs and frame and that there are no faults in the insulation. Pay particular attention to the insulation at the point where the wires are held in metal clips.
9. To remove potentiometer, remove hex nuts. Unsolder leads. Mounting studs are staked to the motor frame. Be sure that the pot strip is clean and that pot arm is not corroded. Use only fine rouge cloth as an abrasive. In replacing the pot be sure the connections are on the side which overhangs the motor.
10. To replace the motor, first remove the pot per Paragraph 9, then unsolder black motor lead if not done in step 9, the red lead from the inside left limit switch lug, and the blue lead from inside right limit switch lug. Fastenings holding motor on studs may then be removed and the motor pulled up and out. In replacing a motor, be sure to see that the round hole in the motor is next to the limit switch. Use special internal-external lockwasher over the stud that works in the slotted hole in the motor. Be sure that the pionion is snug against the spur gear before tightening this fastening over the slot.
11. When it is necessary to closely inspect or replace gears, it is possible to remove motor, limit switch, pot, and terminal strip without unsoldering. Remove motor fastening from the mounting studs. Work motor up and out, exercising care in pulling leads and terminal strip through the window in the gear housing. Remove plate to expose gears. Carefully note positions for proper replacement.

Reassembly of Rotator

It is assumed in the following instructions that the motor and gear train along with potentiometer and limit switch are likewise assembled and wired and operative.

1. See that a small amount of low temperature, high quality, light weight grease is conservatively distributed around the ball bearings, ring gear, and spur gears. Only an even film of grease is desirable (approximately one thimbleful of grease should be used to lubricate a completely dry rotator).

Excessive grease will only run out in high temperatures or cause power loss in low temperatures.

2. Rotate upper spur gear until the inwardly protruding mechanical stop on the right gear engages the channel shaped stop lever and pushes it far enough to the right to just open the right hand limit switch contact (it is assumed that the rotator is viewed from the side of the limit switch). This situation represents the extreme counterclockwise end of rotation. The potentiometer arm must then be rotated to its extreme counterclockwise position against the top brass stop.
3. Secure the upper bell housing upside down by the mast support in a vise with the open end of the "V" toward the bench. The boss which drives the potentiometer arm which is located in the bottom part of the bell housing will then be to the left of center.
4. Clean the inner portion of the housing and apply a small amount of grease to the ball race. Then carefully insert one ball bearing assembly with the flanged rim up and against the outer edge of the casting.
5. Grasp the operating mechanism by the flat base, steady the ring gear, invert the mechanism and lower it into the housing. In doing this, note that the serrated portion of the potentiometer arm must engage the driving boss in the housing and that the three driving lugs on the ring gear must engage the mating lugs in the top housing. This situation will result automatically if the previous instructions have been followed.
6. Determine that the top bearing surface is clean and apply a film of grease on the top ball race and the top bearing assembly. Then apply the top bearing assembly to the race with the rim downward.
7. Clean the retaining ring and apply a light film of grease to the ball race only. Lower the retaining ring into place so that the assembly holes will approximately line up with the threaded holes in the upper housing. Insert the 4 assembly screws and use a heavy screwdriver to completely tighten the 4 assembly screws. Torque to 85 inch pounds.
8. It is suggested that all 8 wires be connected from the control box while the rotor is still on the bench and that its complete operation be checked.

Trouble Shooting Field experience has shown that most operational difficulties with the rotor are traceable to broken, shorted or grounded wires—usually at the terminal strips. Time spent in cutting the leads to exact lengths, tinning, forming, and wrapping around terminals, cutting insulation to exact length, and clamping to prevent strain on any single wire, will pay big dividends later in long and trouble-free performance. Put it up right—and leave it up!

Should trouble occur, first follow the suggestion on page four for "Servicing Control Unit" and "Checking Rotator From Ground". Compare resistance values with Schematic Diagram to localize trouble. The following "symptoms" and "treatments" may also be helpful.

Mechanical Play To prevent binding under adverse operating conditions, a small amount of play is designed into the rotor. Even a degree or so of rotary play will permit several inches movement at the end of a wide antenna boom, or at the tips of the elements. Frequently the slight motion of the antenna array in gusts of wind is due more to the natural flexing of the elements and masts than it is due to actual play in the rotor mechanism.

Antenna Rotates in Heavy Wind This is usually a matter of the mast slipping in the support. A false indication of suspected "slipping" can be obtained by comparing meter readings at different times when the beam has not been "rotated officially." Check the nuts on the U bolts that they are tight. Also check that the center bolt in the mast clamp is tight.

Lack of Power so that antenna rotation is slow or sluggish. Use method on page four to check motor from ground. Check the capacitor. Check transformer for AC output.

If the electrical circuit is OK, then check for mechanical binding. Pay particular attention to bearings and alignment of shaft on an inside tower mount. As a last resort, dismantle the rotor to check gears, bearings, etc.

No Meter Indication The motor operates independent of the indicating system. If the pilot lights burn at proper brilliancy, the instrument transformer is OK and output is not shorted. Check for about 12 VDC across terminals #3 and #7 with switch operated. If this is present, check for 500 ohms across these leads to rotor (disconnected at control box). If 500 ohms is present from #3 and #7, see if the readings from #3 to ground and #7 to ground total 500 ohms. If this is so, connect an auxiliary meter from terminal #3 to ground and see that voltage runs from zero to about 12 volts as antenna is rotated from left to right extremes.

No Rotation — No Indication Either the thermal cutout in the power transformer has opened to protect the motor or capacitor from excessive heat of prolonged operation or there is actually trouble in the circuit. After allowing time for the thermal cutout to restore service, proceed with suggestions above for "lack of power".

Grounded Leads Grounds will burn out either the line fuse or the small fuse in the DC circuit. For full explanations, refer to Schematic. A ground on any of the AC leads #1, #4, #5, #6, or #8 is the same as grounding lead #3 which is common to the AC and DC system. If lead #3 is grounded, it shorts out part of the pot, so that as rotation progresses to the other end, the full DC voltage is applied across a decreasing portion until current becomes so high that it burns out. Note also that any grounds either put an overload on the power transformer which causes the line fuse to blow, or overload the rectifier circuit so that the ⅛ amp. fuse blows.

Meter Fluctuation An intermittent condition in any component in the rectifier or meter circuits within the control box, as well as in the cable or potentiometer circuit in the rotator itself can cause meter fluctuation or error. Possible causes of such trouble may be localized by placing a test DC meter across terminals #3 and #7 and comparing the action of the test meter with the panel meter.

If the test meter fluctuates along with the panel meter, either a component in the rectifier circuit is intermittently defective, or an intermittent trouble-ground is drawing excessive current. To further localize such a condition, leave the test meter on terminals #3-#7 and remove the corresponding leads to the rotator. This removes the load from the DC circuit so the test meter will show about 12 volts. The panel meter sensitivity will be cut about in half, so it will show about ¾ scale. Fluctuation of the test panel meters will now point to trouble in the DC rectifier circuit. Fluctuation of panel meter only, will point to intermittent trouble in the meter, multiplier resistors, or the "cal." pot.

Where the meter is steady in preceding tests, and there is fluctuation with rotator leads connected, it indicates trouble in the lead wires or rotator itself. Any dirt, grease or corrosion that breaks or interferes with the ground return from the potentiometer slide will cause the needle to fluctuate from a true reading toward a center scale point. In such cases it is necessary to open the rotator per instructions on page 4.

PARTS AND PRICE LIST

CONTROL UNIT
HAM - II/CD-44

50940-00 Control Unit, Complete (115 VAC) $89.95

PART NUMBER	DESCRIPTION	Quantity	Price Each
	ELECTRICAL		
10344-03	Fuse, 3 Amp, F-1	1	.30
10733-01*	Transformer, Power 115 VAC-Std on 50940-00	1	14.50
30112-05	Switch, Micro S-3, S4, & S-5	3	1.60
50040-00	Capacitor (120-140 Mfd.) C-2	1	2.50
50153-00	Diode, Zener, D-1	1	4.50
50177-00*	Transformer, Meter 115 VAC-Std. on 50940-00	1	7.00
50183-00	Capacitor (30 MFD) C-1	1	1.30
50202-00*	Transformer, Meter 220 VAC-Std. on 50941-00	1	
50501-00	Diode, 100 Piv. D-2	1	1.00
50513-11	Resistor (10K Ohms 1/2W) R-1	1	.35
50513-12	Resistor (180 Ohms 1W) R-2	1	.35
50563-00	Fuse, ⅛ Amp., F-2	1	.30

PART NUMBER	DESCRIPTION	Quantity	Price Each
50861-00	Line Cord, 3 Wire	1	$ 2.00
50883-00	Meter, Lamp Holder, and Bezel (N" Center)	1	23.10
50895-00	Bulb, Meter	1	.90
50899-00	Switch, On-Off, S-1	1	2.00
50900-00	Switch, Calibration, S-2	1	5.60
	SHEET METAL AND HARDWARE		
10555-00	Strip, Solder Terminal	1	.50
10563-00	Holder, Fuse, F-1	1	1.90
30362-05	Spring, Extension (Meter Bezel)	2	.30
50185-00	Holder, Fuse, F-2	1	.60
50187-00	Knob, Switch	2	1.00
50194-00	Clamp, Cable	1	.20
50300-00	Bumper, Rubber	4	.15
50399-00	Strip, Terminal (8 Pin)	1	.70
50884-00	Lever, Switch (Direction & Brake)	3	.60
50885-00	Cover, Top (Tan)	1	4.00
50886-00	Cover, Botton (Brown)	1	4.50
50890-00	Face Plate	1	3.10
50891-00	Chassis	1	6.00

*Note: 115 VAC control unit can be converted to 220 VAC by installation of the 220 VAC power and meter transformers.

10735-01 Transformer, Power, 220 VAC
50202-00 Transformer, Meter, 220 VAC

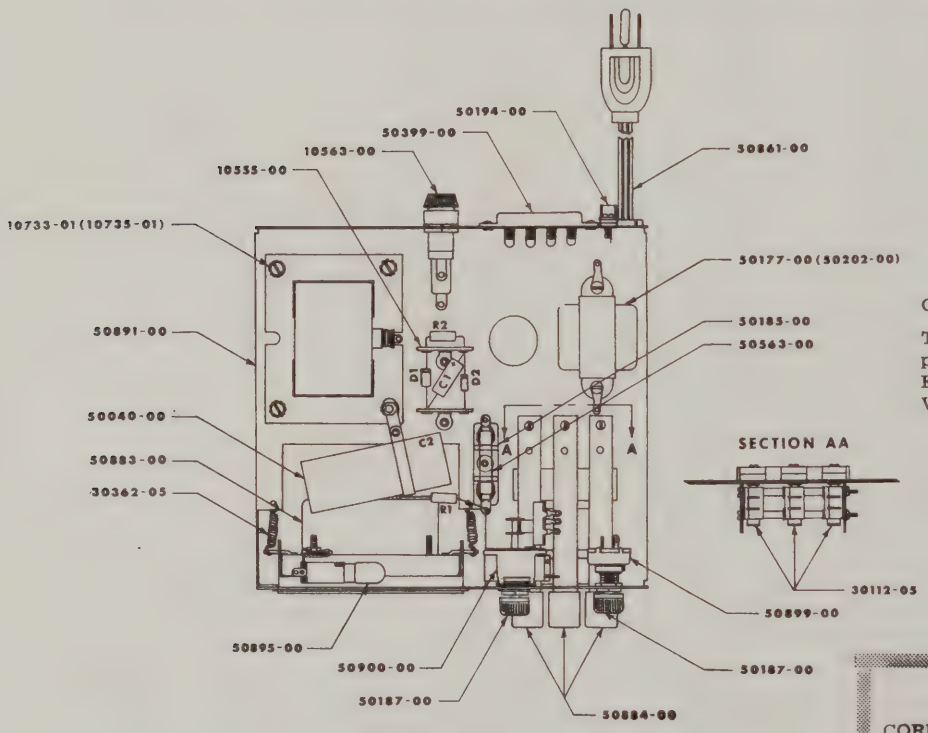


Figure 1

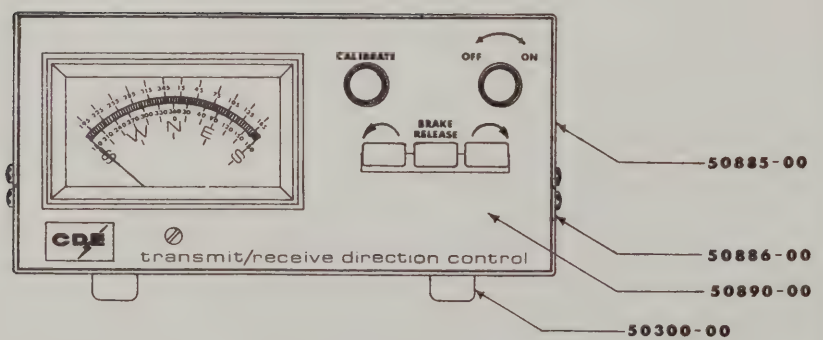


Figure 2

ORDER PARTS USING COMPLETE NUMBER & DESCRIPTION

To order parts, remit check or money order for total parts cost plus $1.00 for postage and handling to: Cornell - Dubilier Electronics, Department "C", 118 E. Jones Street, Fuquay - Varina, N. C. 27526

LIMITED WARRANTY

CORNELL-DUBILIER ELECTRONICS warrants each new CORNELL-DUBILIER ROTOR to be free from defect in material arising from normal usage. Its obligation under this warranty is limited to replacing, or at its option repairing the rotor which, after regular installation and under normal usage and service, shall be returned within **ONE (1) YEAR** from date of original consumer purchase of the rotor to **Cornell-Dubilier Electronics, Rotor Service Dept., 118 E. Jones St., Fuquay-Varina, N. C. 27526**, together with satisfactory evidence of such purchase, and which shall be found to have been thus defective in accordance with the policies established by CORNELL-DUBILIER ELECTRONICS.

The obligation of CORNELL-DUBILIER ELECTRONICS does not include either the making or the furnishing of any labor in connection with the installation of such repaired or replacement rotor, nor does it include responsibility for any transportation expense.

CONDITIONS AND EXCLUSIONS

This warranty is expressly in lieu of all other agreements and warranties, expressed or implied, and CORNELL-DUBILIER ELECTRONICS does not authorize any person to assume for it the obligation contained in this warranty and neither assumes nor authorizes any representative or other person to assume for it any other liability in connection with such CORNELL-DUBILIER Rotor.

The warranty herein extends only to the original consumer and is not assignable or transferable, and shall not apply to any rotor which has been subject to alternation, misuse, negligence or accident.

CORNELL-DUBILIER ELECTRONICS
118 E. Jones Street
Fuquay-Varina, N. C. 27526

PARTS AND PRICE LIST

ROTATOR UNIT
CD-44

PART NO.	DESCRIPTION	QUANTITY	PRICE EACH
50241-00	Rotator Unit Assembly	1	$47.95
50090-00	End of Rotation Switch Assembly	1	3.30
50107-00	Final Spur Gear	2	2.40
50113-00	Ball Retainer	2	1.10
50122-00	Motor Mounting Plate with Studs	1	2.50
50231-00	Potentiometer Assembly (Complete)	1	9.60
50304-00	Upper Mast Support (Bell Casting)	1	7.00
50425-10	Retaining Ring	1	3.60
50310-00	Motor Pinion	1	.50
50313-10	Ring Gear—Casting Kit	1	2.50
50335-01	Ball Bearings	50	.12
50399-00	Terminal Board Assembly (8 Terminals)	1	.70
50423-10	Stop Lever Assembly Kit	1	1.00
50341-01	Small Gear Spacer (Brass)	1	.30
50346-01	Gear & Pinion (1st, 2nd, & 3rd from Motor	3	1.20
50369-00	Gear & Pnion (Thick Pinion, 4th. from Motor)	1	1.50
50370-10	Base Kit	1	5.10
50504-00	Motor & Pinion Ass'y	1	14.25
50378-00	Large Gear Spacer (Steel)	1	.40
50379-00	Bushing for Final Gear	1	.40
50349-10	Lower Mast Support Assembly Kit	1	4.50
51057-00	Hex Hd. Screw (Taptite) 12-24x¾	4	.15
02-06006-061	#6—32 x ⅜" Self Tap Screw	2	.10
51234-00	Retainer for Stop Lever Assembly	1	.15
51120-00	Washer	3	.10
50463-10	Mounting Kit	1	6.00

(2) 50115-00 Mast Clamp
(4) 50382-00 "U" Type Bolt (Stn. Stl.)
(4) 50502-00 Spacer
(6) Srew, Hex Hd. ¼-20x1¼
(10) Hex Nut ¼-20 (Stn. Stl.)
(14) Lockwasher, Split ¼"

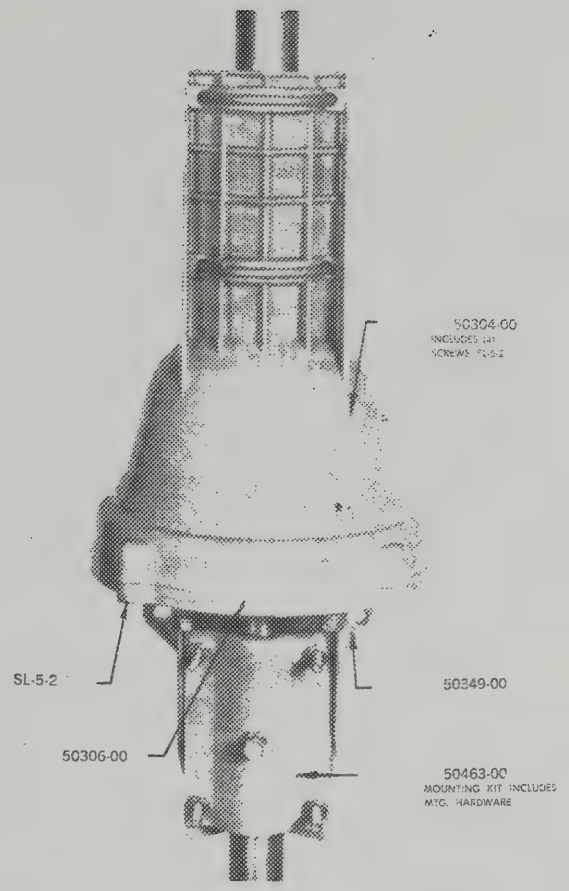


Figure 3

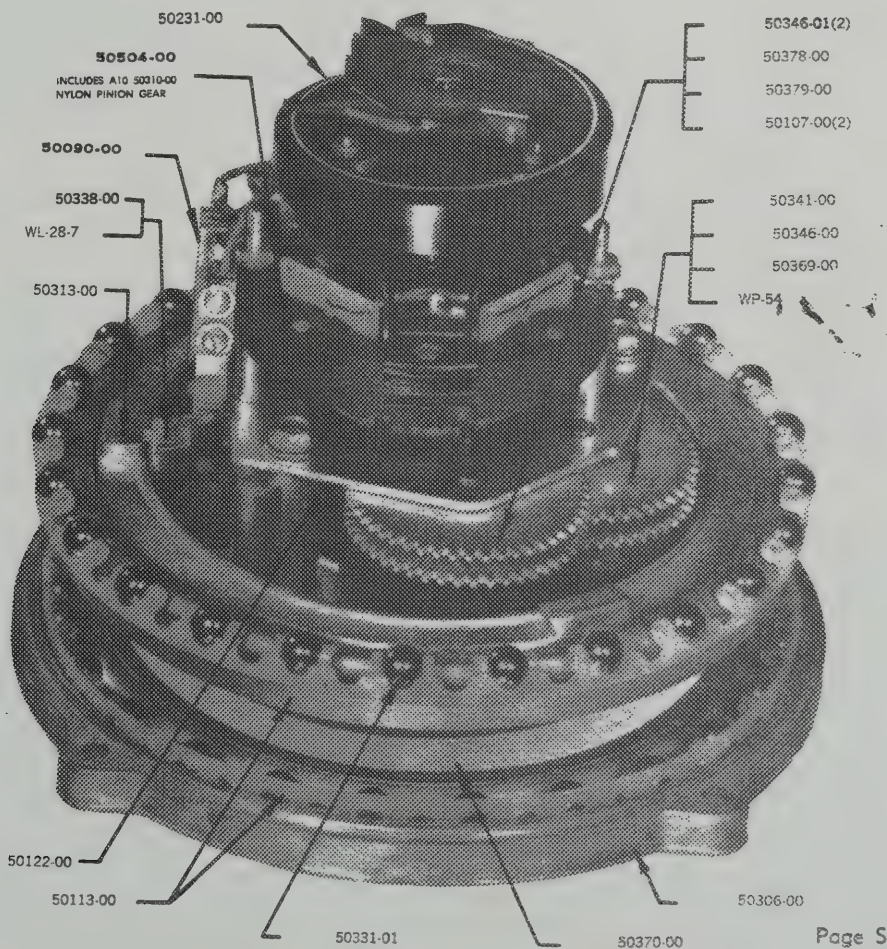


Figure 4

- Input voltage: 115 VAC 50-60 HZ.
  Optional: 220 VAC 50-60 HZ.
- Motor: 24 VAC, 2.25 Amp, split phase.
- Power transformer: 115/26 VAC 10% duty, thermal protected.
  Optional: 220/26 VAC 50-60 HZ.
- Meter transformer: 115/23 VAC continuous duty.
  Optional: 220/23 VAC.
- Meter: D.C. voltmeter 1000 ohms/volt.
- Meter scale: Direct reading, North centered. 5° increments.
  Optional: South centered.
- Recommended cable: Belden 8448 or equivalent for up to 45 meters (150 feet).
- Maximum cable resistance: 1.0 Ohm for terminal 1, 2.5 Ohms for terminal 3-8.
- Rotation time: 45-60 seconds with 60 HZ input.
- Brake: Disc type. integral part of the motor armature.
- Rotator size: 20 cm (8") maximum diameter by 44 cm (17⅜") high with lower mast support. Without lower mast support, 28 cm (10⅞").
- Permissable mast size: From 35 mm (1.37") to 52 mm (2.062").
- Control box size: 20.5 cm (8.125") wide x 21 cm (8.25") deep x 10.5 cm (4.125") high.
- Mounting hardware: Stainless steel.
- Shipping cubature: 37,350 cucms (2280 cu in).
- Shipping weight: 10.88 kg (24 pounds).

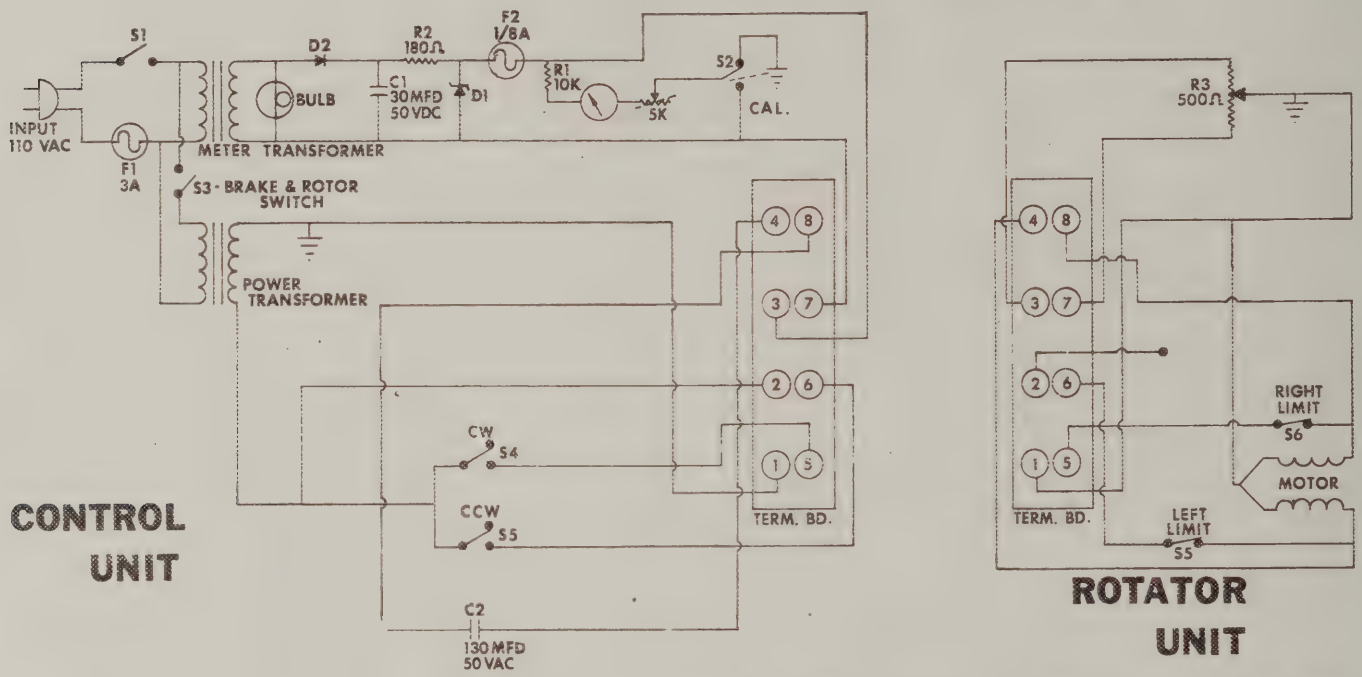


Figure 5

NOTE: USE #18 WIRES FOR TERMINALS 1 & 2.

ACCESSORY KITS

ALTERNATE METER SCALE

50924-10 South Center Meter Scale Kit 3.00

The stock Ham II/CD-44 control unit is produced with a North Centered meter scale. Since some locations and/or popular working areas may favor rotation stops at North, we provide a South Centered meter scale kit for field modification.

INSIDE TOWER MOUNTS

50559-10 Tower Mounting Plate Kit 4.50

A cylindrical space of 21.6 cm (8.5 inches) diameter and 38.1 cm (15 inches) height will accommodate the CD-44 rotator bolted to a flat plate without the lower mast support attached. To facilitate such mounting, a steel plate, cut out to fit against the bottom of the brakehousing and clear the terminals, is available. This plate, part number 50559-10, has four heavy bushings drilled to match the screw holes and to hold the rotor 2.7 mm (.5 inches) above the tower plate in order to provide clearance for the control cable.

On any inside tower installation, care must be exercised to get the top mast shimmed to the exact rotational center of the rotator upper mast support. The geometry is such that a mast of 52 mm (2.062 inches) will be exactly centered. For each 1.6 mm (.0625 inches) less mast diameter used, .8 mm (.031 inches) of shim must be wrapped around the mast at the clamping points.

CLASS 252.45

CDR HAM ROTOR

Service Manual

MODEL TR-44

CDE

CORNELL-DUBILIER ELECTRONICS

DIVISION OF FEDERAL PACIFIC ELECTRIC COMPANY

Rotor Department

Fuquay-Varina, North Carolina

Service Manual FOR CDR ROTOR

MODEL TR-44

Foreword On the following pages, you will find information obtained from the Engineering Staff where the CDR Rotors are built, the Service Engineering Group, and from amateurs who have TR-44 Rotors installed. No attempt has been made to detail every possible installation or suggest every maintenance procedure that may be necessary to cover many years of operation.
Please feel free to communicate with us at any time that we may be of assistance. Write to:

CORNELL-DUBILIER ELECTRONICS
DIVISION OF FEDERAL PACIFIC ELECTRIC COMPANY
CDR Rotor Department
118 E. Jones Street
Fuquay-Varina, North Carolina

General The TR-44 Rotor is designed to support moderately large antenna arrangements and provide for rotation of such antennas through a complete 360 degree range. Position of the antenna is indicated on a meter in the control box.

This rotor is built along the general lines of the original TR-2 and TR-4 rotors which have been used extensively for television reception for many years. The weight of the upper mast and antenna is carried directly in line with the supporting mast. The rotor, radial and thrust bearings, gear train and indicating mechanism are specially built into an elongated bell shaped housing made of aluminum.

Specifications

Input voltage	115 VAC 60 Cycles (105-125)
Motor	24 V., 1¾ Amp., Split phase 10% duty
Capacitor	185-210 MFD—Electrolytic 10% duty
Power Transformer	115/26 VAC, 10% duty, Thermal cutout
Meter	DC Milliammeter 0-1 MA
Meter Scale	Direct reading in degrees from North (5 degree increments)
Recommended Cable	Belden #8467 or equivalent. 7 wires #18
Max. Cable Resistance for Proper Operation	Not over 1 Ohm (This is about 150 ft. #8467 cable)
Indicating Accuracy	Within 5 degrees of true compass direction when exactly calibrated
360° Rotation Time	Approximately 50 seconds
Control Box Size	5 13/16" wide, 6" deep, 5¼" high
Rotator Dimensions	8" max. dia. x 17⅜" high with top and bottom mast supports. Less lower mast—10⅞" high
Weight (Pounds)	Rotator with top mast support — 8¾. Lower mast support only—2½. Control box complete—5¾. Total shipping weight 19¼ lbs. approx.
Permissible Mast Size	From ⅞" to 2 1/16" diameter
Mounting Hardware	¼" Stainless steel "U" bolts and nuts.

Checking Control Unit It is recommended that a preliminary check be made on the control unit and the rotor itself before actual installation to detect possible shipping damage.

To check the control unit, plug it into 110 volt AC power. With a jumper between terminals #1 and #7, operate the control lever to the left slightly. The meter should read full scale. Turning the adjusting control on the rear of the unit should cause some change in the meter deflection. Check for similar operation with the control lever pushed slightly to the right. To check the power circuit, connect an AC voltmeter between terminals 4 and 7 on the rear panel and see that approximately 30 volts is indicated when the control lever is shifted to the extreme right. Connect the same meter between terminals 5 and 7 and see that approximately 30 volts is indicated as the control lever is moved to the extreme **left** only.

Checking Rotator Connect all 7 terminals of the control box to the corresponding 7 terminals of the rotor using the coil of cable obtained for the installation. CAUTION — SHORTS BETWEEN TERMINALS OR GROUNDED LEADS MAY BURN UP THE POT STRIP IN ROTATOR.

With the rotor in an upright position without the lower mast support assembled, operate rotator by means of control unit lever in both directions.

Meter Calibration Run rotator to full left extreme and use zero-center screw to put needle exactly on left limit while holding lever operated. Then run to right extreme and adjust calibrating control on rear to put needle exactly on right limit. Left end adjustment depends only on installation. Right hand adjustment varies with line voltage and must be rechecked periodically if extreme accuracy of indication is desired.

Recheck of calibration requires rotation of antenna to right hand extreme.

Rotor Installation The TR-44 rotor is engineered to handle antennas with relatively high wind resistance. Long and trouble-free performance of the rotor with antennas of different types, depends upon making an installation to properly handle the stresses involved.

1. The center-of-gravity and center of wind load force of the antenna should be as close to the top of the rotor casting as possible. One to three feet is practical with most installations. When the array is stacked and an antenna with a boom length exceeding 8 ft. is to be mounted more than 5 ft. above the top of the rotor, use of a heavy duty tower with the rotor mounted inside is mandatory. The antenna support pipe then should be 2 inch O.D. steel with ¼ inch wall, rotating in a ball-thrust bearing at the top of the tower. The rotor should be mounted inside the tower within 4 feet of this bearing to minimize rotating whip in the tubing. All reliable tower manufacturers will be glad to advise the best method for inside mounting with their product. A rugged mount can be made easily with angle iron and "U" bolts that will fit any tower.

   A typical installation requiring this type of mounting would be a medium-sized Tri-band antenna one foot above the top of the tower and a combination six-two meter array mounted 10 feet above.

BI-284-REV. B. 11-65

2. The TR-44 easily mounts on a pipe or top of tower, but certain precautions must be observed to obtain good service. The rotor can be subjected to tremendous leverage forces mounted in this manner, but the thousands of long term successful "top" installations prove its potential feasibility. A careful survey of hundreds of such installations points up several factors. The center-of-gravity and wind loading of the antenna array must be centered over the rotor and not more than 12 inches above it if any part of the antenna array is more than 10 feet from the rotor. The reasoning behind this is simple. The ball-thrust bearing races in the base of the TR-44 are just over 6 inches in diameter. 50 lbs. exerted against a 10 ft. lever will place approximately 2,000 lbs. of "pinch" on these bearings. Each additional foot of leverage or pound of force multiplies this value by a high ratio. Extreme care should be used in any very high, top of clear hill installations. Here the wind forces may be applied at odd angles, such as, a severe up-draft that lifts one side of the antenna array, multiplying leverage many-fold.

   Some typical installations that "top" mounting of the TR-44 Rotor can handle in coverage installations would be: Single medium Tri-band 12 inches above top of rotor; stack of a six element 6 meter beam just above rotor with 8 element 2 meter antenna mounted not more than 5 ft. above it; "Box 4" array of four 8 element 2 meter yagis with the center not more than 1 ft. above rotor; and Quads of reasonable size and weight arranged to place the center of gravity inside the rotor.

3. Every effort should be made to eliminate any source of flexure in the mount or antenna. During even moderate breezes, such flexing can set up an oscillating motion that results in thousands of pounds of torque or bending moment. The two degrees of "lost motion" built into every CDR rotor acts as a vibration dampener but can only counteract for moderate swing. After determining proper orientation of rotor and antenna, we suggest that a 3/8" hole be bored through the tapped pilot hole in the upper and lower clamp plates ARU-68—through the support mast—and out through the "V" casting TRA-1 & TRA-44. Then run a 3/8" stainless steel bolt and nut of the proper length, tighten securely, through the whole assembly. This is the only known method of insuring no slip at these two points with a large array. The same treatment should be given any large antenna where it mounts on the support pipe.

4. To summarize: Successful operation of the TR-44 with moderately large antennas is assured if a proper mechanical installation commensurate with the total size of the entire system is made. Please do not attempt another "Easy" 10 ft. by attempting to mount an antenna of any size on top of a 1¼ inch "T.V." mast on top of the rotor—you are just going to pick up pieces after the first wind gust! Do provide a good mechanically solid support for the rotor at the height desired for the antenna; then keep the center of gravity of the array close to the top of the rotor. If there is any doubt about a "Top" mount, then invest in a good inside tower installation; it is an excellent investment.

Inside Tower Mounts A cylindrical space of 8¼" diameter and 12" height will accommodate the TR-44 Rotor bolted to a flat plate without lower mast clamp attached.

ON ANY INSIDE TOWER INSTALLATION, GREAT CARE MUST BE EXERCISED TO GET THE TOP MAST SHIMMED TO EXACT CENTER OF THE ROTOR MAST SUPPORT. The geometry is such that a 2 1/16" diameter will be exactly centered. For each 1/16" less diameter used, 1/32" thickness of aluminum must be used around the mast or at least on each side of the V support. To center a 2" O.D. mast, use 1/32" thick shims.

Balanced Weight produces only down-thrust on the rotor. With 50 ball bearings operating in accurately machined races, the rotor is capable of handling considerable downward pressure in line with the axis of rotation.

Unbalanced Weight creates a bending moment of force which is concentrated on the mast at the point where it is clamped to the top of the rotor. This moment tends to strain the mast at that point and also to bind the ball bearings by creating excessive downward pressure on one side and upward pressure on the other. Such unbalance places additional stresses on the motor and gear train. Unbalanced weight becomes critical as the distance from the antenna boom to the clamping point at the rotor is increased.

Wind Pressure against the boom and elements usually produces a bending force on the mast which causes the same stresses as unbalanced weight. To strengthen the installation to withstand unbalanced weight and wind pressure, the top mast should be as short as possible. In order to distribute the bending stress and prevent fracture of the mast, the TR-44 rotor includes two long, heavy, specially designed steel clamping plates. These are grooved to grip the mast securely. It is recommended that the mast be reinforced in the area where it is clamped by driving a hardwood dowel of proper size into the end of the mast.

Start-stop Torsion Torsional or twisting forces must be given special considerations when using the TR-44 Rotor.

The rotating inertia of the antenna in motion must be safely absorbed when the rotor stops. It is essential that all mechanical assemblies making up the antenna array be solidly clamped so that no slipping occurs even under heavy icing conditions. Particular attention must be given to clamping of the boom to the mast, and the masts to the rotor, as the greatest leverage occurs at these points.

Mechanical Description The motor drives a train of spur and pinion speed reduction gears which in turn drive the ring gear. The ring gear drives the bell shaped upper mast support, into which the antenna mast is mounted in rigid central alignment.

A boss is cast on the under side and in the center of the cavity of the upper mast support, which engages the serrated edge of the potentiometer arm which is mounted on the top of inner mechanism.

Maximum support and low frictional loss between the rotating upper mast support and the inner mechanism is assured by the use of two groups of 25 steel balls each riding in the bearing races between the two assemblies, and held in special nylon retainers.

Mechanical stops along with electrical limit switches are built into the rotor mechanism to provide accurate and complete 360 degree rotation.

Circuit Description The power transformer supplies approximately 30V. AC for operating the motor when the control lever is moved completely to the left or right of the mid-position. Overheating of the transformer from prolonged operation or possible short circuit is prevented by a thermal cut-out switch in the primary winding.

The motor is a two-phase device, the first winding is supplied AC direct from the transformer, while the second has a 100-

130 mfd. capacitor in series in order to shift the phase and provide forward rotational torque. To reverse, the capacitor is switched in series with the first winding, while the second is directly supplied from the transformer. This switching is done by simply moving the control lever from side to side, the center position is off, and cuts the line voltage off the entire unit.

The transformer is energized as the control lever is moved slightly to the left or right of mid-position. It supplies approximately 14 VDC through a capacitor, rectifier and zener diode to the 500 ohm potentiometer in the rotator.

The meter is a high quality DC instrument requiring 1 MA for full scale deflection. It is connected with plus side through the 10K multiplier to the plus side of the pot. The meter circuit is completed through the 5K calibrating control on the rear to the pot arm which is grounded.

Two electrical limit switches in the rotator cut the motor power just before the rotation reaches the extremes. A fuse is included in one side of the supply line. The calibrating control, accessible from the rear, is used to establish exact readings for the particular line voltage present.

Servicing the Control Unit

Disconnect the AC power source and remove the seven-wire cable. Tag each wire with its number.

Read Resistance	Between Terminals	Switch Lever
11K to 16K	1-2	Center
18K to 25K	1-4*	Right
18K to 25K	1-5*	Left
18K to 25K	1-7*	Center
2700	2-4*	Right
2700	2-5*	Left
2700	2-7*	Center
0	4-7*	Right
0	5-7*	Left

*plus lead on first terminal indicated

With power cord connected and jumper from terminals #1-7 meter, should read full scale when pot is adjusted.

Read Voltage	Between Terminals	Switch Lever
14VDC	2-7	Right or Left
26VAC	4-7	Right
26VAC	5-7	Left

Checking the Rotator from the Ground

One may possibly avoid bringing the rotator down from the mast by making electrical checks from the position of the control box. This is done by disconnecting the seven wires from the screw terminals and tagging them carefully #1 through #7 to correspond with the terminal numbers from which they are removed. From the schematic diagram it is apparent that the resistance of the lead wires will be added to the resistance of the motor windings and potentiometer strip in making the resistance checks.

Leads of #18 AWG have approximately 0.64 ohm resistance per 100 feet. Use a low resistance ohmmeter to check the values shown in the table below to an accuracy of 10 percent after adding the resistance of the leads involved.

To Check	Resistance Series 1	Resistance Series 2	Between Terminals
½ Motor Winding	2.5 ohms*	1.6 ohms*	3 - 7
½ Motor Winding	2.5 ohms*	1.6 ohms*	6 - 7
½ Motor + Switch	2.5 ohms*	1.6 ohms*	4 - 7
½ Motor + Switch	2.5 ohms*	1.6 ohms*	5 - 7
Entire Motor	5 ohms*	3.2 ohms*	3 - 6
Right Limit Switch	0 ohms + leads		3 - 4
Left Limit Switch	0 ohms + leads		5 - 6
Entire Pot Strip	500 ohms		2 - 7
Pot Arm to + End	0 to 500 ohms		1 - 7
Pot Arm to − End	0 to 500 ohms		1 - 2

* plus leads

Disassembly of Rotator

1. Remove the bottom mast support to permit the rotator to be set on a flat bench.
2. Remove four screws and carefully raise top casting to ex-

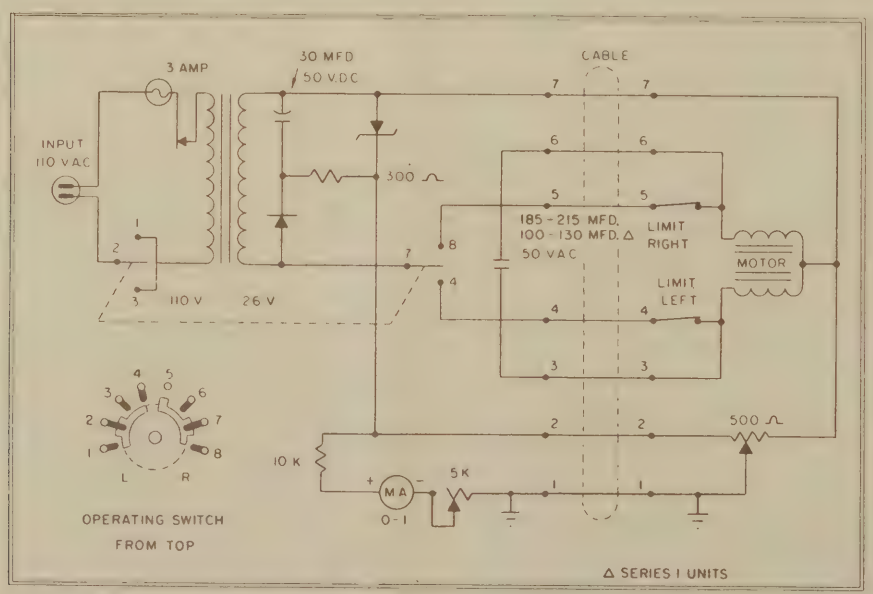


Fig. 1 — Schematic Diagram

pose potentiometer and drive mechanism.

3. Carefully remove upper ball retaining ring. Keep it circular, and lay it on clean paper.

4. Inspect inside of top housing for small scratches or burned spots on the ribs. These are an indication that a switch blade or connection is rubbing during rotation. See that the pot strip is clean and not burned at either end. See that pot body is secure and that pot arm is clean at the point of contact. Use only fine rouge cloth to polish contact arm. Check limit switch to see if wires are secure and insulation is undamaged. Contacts should be clean. Check for 1/32" clearance between switch blades and motor—particularly alongside of lockwasher under motor fastening. Greater clearance gets switch too close to top bell housing ribs.

5. If the drive ring happens to be near end of rotation, operate the top spur gear to rotate the mechanical stop on the drive ring away from the area of the limit switch. See that the mechanical stop lever (which is positioned between the two limit switches) will open each electrical contact before it hits the corresponding mechanical stop. Also see that the stop lever has not been deformed and that the electrical contacts are clean and uncorroded.

6. Rotate the top spur gear several revolutions to determine that the motor and its bearings are operating freely. Look for broken teeth in any of the gears.

7. Remove the drive ring gear from the base housing. This is accomplished by first pulling up on the side opposite the gear train. Then raise the entire ring slightly upward with the side away from the gear train higher so that it will slide out from under the gears. Examine closely for evidence of broken or worn teeth.

8. Examine the inside of the screw terminal strip to see that there is proper clearance between the solid lugs and frame and that there are no faults in the insulation. Pay particular attention to the insulation at the point where the wires are held in metal clips.

9. To remove potentiometer, remove hex nuts. Unsolder leads. Mounting studs are staked to the motor frame. Be sure that the pot strip is clean and that pot arm is not corroded. Use only fine rouge cloth as an abrasive. In replacing the pot be sure the connections are on the side which overhangs the motor.

10. To replace the motor, first remove the pot per Paragraph 9, then unsolder black motor lead if not done in step 9, the red lead from inside left limit switch lug, and the blue lead from inside right limit switch lug. Fastenings holding motor on studs may then be removed and the motor pulled up and out. In replacing a motor, be sure to see that the round hole in the motor is next to the limit switch. Use special internal-external lockwasher over the stud that works in the slotted hole in the motor. Be sure that the pinion is snug against the spur gear before tightening this fastening over the slot.

11. When it is necessary to closely inspect or replace gears, it is possible to remove motor, limit switch, pot, and terminal strip without unsoldering. Remove motor fastening from the mounting studs. Work motor up and out, exercising care in pulling leads and terminal strip through the window in the gear housing. Remove plate to expose gears. Carefully note positions for proper replacement.

Final Reassembly of Rotator

It is assumed in the following instruction that the motor and gear train along with potentiometer and limit switch are likewise assembled and wired and operative.

1. See that a small amount of low temperature, high quality, light weight grease is conservatively distributed around the ball bearings, ring gear, and spur gears. Only an even film of grease is desirable (approximately one thimbleful of grease should be used to lubricate a completely dry rotator). Excessive grease will only run out in high temperatures or cause power loss in low temperatures.

2. Rotate upper spur gear until the inwardly protruding mechanical stop on the ring gear engages the channel shaped stop lever and pushes it far enough to the right to just open the right hand limit switch contact (it is assumed that the rotator is viewed from the side of the limit switch). This situation represents the extreme counterclockwise end of rotation. The potentiometer arm must then be rotated to its extreme counter-clockwise position against the top brass stop.

3. Secure the upper bell housing upside down by the mast support in a vise with the open end of the "V" toward the bench. The boss which drives the potentiometer arm which is located in the bottom part of the ball housing will then be to the left of center.

4. Clean the inner portion of the housing and apply a small amount of grease to the ball race. Then carefully insert one ball bearing assembly with the flanged rim up and against the outer edge of the casting.

5. Grasp the operating mechanism by the flat base, steady the ring gear, invert the mechanism and lower it into the housing. In doing this, note that the serrated portion of the potentiometer arm must engage the driving boss in the housing and that the three driving lugs on the ring gear must engage the mating lugs in the top housing. This situation will result automatically if the previous instructions have been followed.

6. Determine that the top bearing surface is clean and apply a film of grease on the top ball race and the top bearing assembly. Then apply the top bearing assembly to the race with the rim downward.

7. Clean the retaining ring and apply a light film of grease to the ball race only. Lower the retaining ring into place so that the assembly holes will approximately line up with the threaded holes in the upper housing. Insert the 4 assembly screws and use a heavy screwdriver to completely tighten the 4 assembly screws.

8. It is suggested that all 7 wires be connected from the control box while the rotor is still on the bench and that its complete operation be checked.

TROUBLE SHOOTING

Field experience has shown that most operational difficulties with the rotor are traceable to broken, shorted or grounded wires—usually at the terminal strips. Time spent in cutting the leads to exact lengths, tinning, forming, and wrapping around terminals, cutting insulation to exact length, and clamping to prevent strain on any single wire, will pay big dividends later in long and trouble-free performance. Put it up right—and leave it up!

Should trouble occur, first follow the suggestion on page four for "Servicing Control Unit" and "Checking Rotator From Ground". Compare resistance values with Schematic Diagram to localize trouble. The following "symptoms" and "treatments" may also be helpful.

Mechanical Play To prevent binding under adverse operating conditions, a small amount of play is designed into the rotor. Even a degree or so of rotary play will permit several inches movement at the end of a wide antenna boom, or at the tips of the elements. Frequently the slight motion of the antenna array in gusts of wind is due more to the natural flexing of the elements and masts than it is due to actual play in the rotor mechanism.

Antenna Rotates in Heavy Wind This is usually a matter of the mast slipping in the support. A false indication of suspected "slipping" can be obtained by comparing meter readings at different times when the beam has not been "rotated officially." Check the nuts on the U bolts that they are tight. Also check that the center bolt in the mast clamp is tight.

Lack of Power so that antenna rotation is slow or sluggish. Use method on page four to check motor from ground. Check the capacitor. Check transformer for AC output.

If the electrical circuit is OK, then check for mechanical binding- Pay particular attention to bearings and alignment of shaft on an inside tower mount. As a last resort, dismantle the rotor to check gears, bearings, etc.

No Meter Indication If the instrument transformer is OK and output is not shorted, check for about 14 VDC across terminals #2 and #7 with switch operated. If this is present, check for 500 ohms across these leads to rotor (disconnected at control box). If 500 ohms is present from #2 and #7, see if the reading from #2 to ground and #7 to ground total 500 ohms. If this is so, connect an auxiliary meter from terminal #7 to ground and see that voltage runs from zero to about 14 VDC as antenna is rotated from left to right extremes.

No Rotation — No Indication Either the thermal cutout in the power transformer has opened to protect the motor or capacitor from excessive heat of prolonged operation or there is actually trouble in the circuit. After allowing time for the thermal cutout to restore service, proceed with suggestions above for "lack of power".

Grounded Leads Grounds on cable leads can cause completely erroneous readings and even burn out the pot strip. For full explanations, refer to Schematic on page four. Note that a ground on any of the AC leads #3, #4, #5, or #6, can cause the pot to burn out. If lead #2 is grounded, it shorts out part of the pot, so that as rotation progresses to the other end, the full DC voltage is applied across a decreasing portion until current becomes so high that it burns out.

Meter Fluctuation An intermittent condition in any component in the rectifier or meter circuits within the control box, as well as in the cable or potentiometer circuit in the rotator itself can cause meter fluctuation or error. Possible causes of such trouble may be localized by placing a test DC meter across terminals #1 and#7. The test meter will show about 14 VDC.

Where the meters are steady in preceding tests, and there is fluctuation with rotator leads connected, it indicates trouble in the lead wires or rotator itself. Any dirt, grease or corrosion that breaks or interferes with the ground return will not allow any meter movement. In such cases it is necessary to open the rotator per instructions on page four. The ground connection is carried through the potentiometer pivot directly to the frame.

PARTS AND PRICE LIST

FOR CONTROL UNIT

[For ordering procedures See Page 8]

Part No	Name	Quantity	Price Each
MCU-178	Control Unit Assembly	1	$30.00
TRB-67	Motor Capacitor, 185-215 Mfd. 50 VAC	1	3.00
FG-303	Fuse, 3 Amp 3 AG	1	.20
H-334	Silicon Rectifier	1	2.50
H-368	Zener Diode	1	5.00
IT-69	Terminal Strip	2	.10
MCU-5-1	Switch Handle Assembly	1	.50
MCU-103	Wafer Switch	1	1.90
MCU-108-1	Potentiometer, 5K, W.W. 2 Watt	1	1.50
MCU-109	Capacitor, 30 Mfd. 50 VDC	1	1.50
MCU-112	Fuse Holder	1	.40
MCU-116	Potentiometer Knob	1	.25
MCU-127-2	Meter, O-1 MA, special (North Center Scale)	1	20.00
MCU-148-2	Meter Crystal	1	1.95
MX-82	Control Cabinet	1	3.75
RP-36	Recess Bumper	4	.05
TRA-21	Terminal Board	1	.60
MCU-101	Transformer	1	9.00
W-758	Resistor 300 Ohm, 1 Watt	1	.25
W-759	Resistor 10K Ohms, 1 Watt	1	.25
WM-12	AC Cord	1	.80
ACU-96*	Transformer	1	5.75
TRB-4*	Motor Capacitor, 100-130 Mfd. 50 VAC	1	3.00

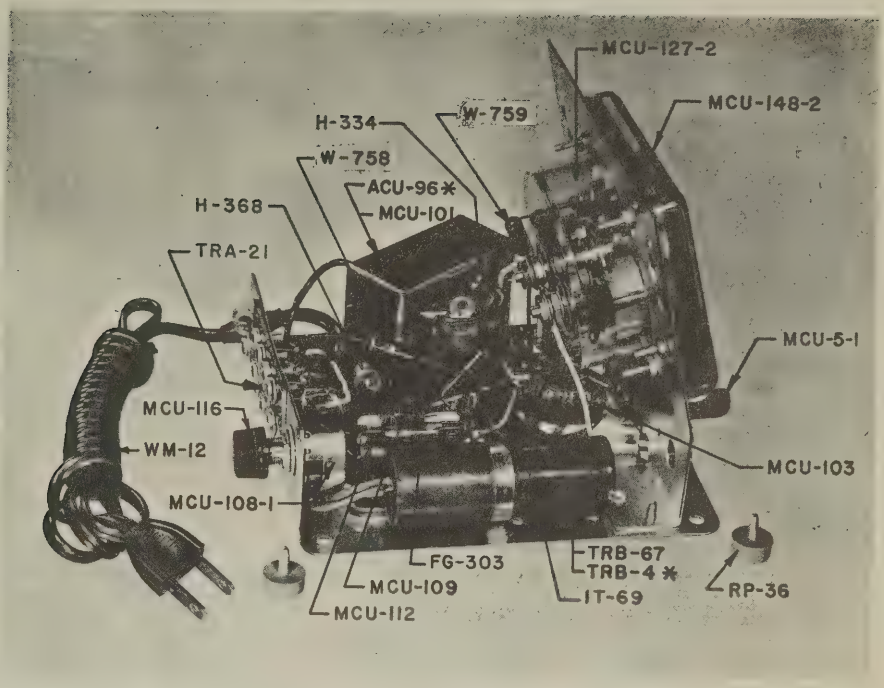


Fig. 2

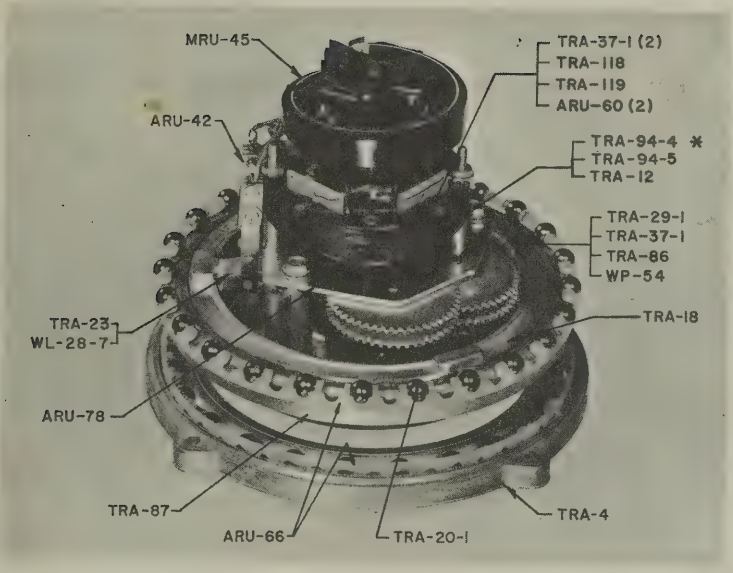


Fig. 3

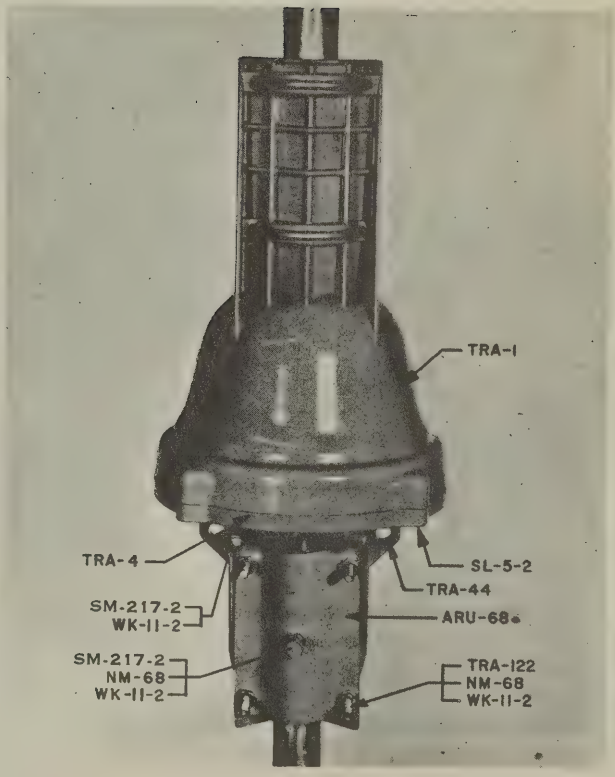


Fig. 4

* Series 1 Units

PARTS AND PRICE LIST

FOR TR-44 ROTATOR UNIT

(For ordering procedures See Below)

Part No.	Name	Quantity	Price Each
MRU-68	Rotator Unit Assembly	1	$37.15
ARU-42	End of Rotation Switch Assembly	1	2.75
ARU-60	Final Spur Gear	2	1.75
ARU-66	Ball Retainer	2	.75
ARU-78	Motor Mounting Plate with Studs	1	1.75
MRU-45	Potentiometer Assembly	1	6.75
TRA-1	Upper Mast Support (Bell Casting)	1	8.50
TRA-4	Retaining Ring—Casting	1	1.25
TRA-12	Motor Pinion	1	.40
TRA-18	Ring Gear—Casting	1	1.25
TRA-20-1	Ball Bearings	50	.05
TRA-21	Terminal Board Assembly	1	.60
TRA-23	Stop Lever Assembly	1	.30
TRA-29-1	Small Gear Spacer	1	.10
TRA-37-1	Gear & Pinion (1st, 2nd, & 3rd. from Motor	3	.75
TRA-86	Gear & Pinion (Thick Pinion, 4th. from Motor	1	.90
TRA-87	Base Casting	1	4.00
TRA-94-4	Motor with Potentiometer Mount Attached	1	9.75
TRA-118	Large Gear Spacer	1	.25
TRA-119	Bushing for Final Gear	1	.30
TRA-122	1/4"—20 Stainless U Bolt	4	.40
SL-5-2	#12—28 x 5/8 Fillister Head Sems Screw	4	.05
SS-64-2	#6—32 x 3/8" Self Tap Screw	2	.05
WL-28-7	Retainer for Stop Lever Assembly	1	.05
WP-54	Washer	3	.05
TRA-44	Lower Mast Support Assembly	1	4.25
AK-128	Accessory Kit	1	5.00
ARU-68	Clamp Plate	2	.75
NM-68	1/4"—20 Stainless Hex Nut	10	.10
SM-217-2	1/4"—20 x 1 1/4" Hex Machine Screw	6	.05
TRA-122	1/4"—20 Stainless U Bolt	4	.40
WK-11-2	1/4"—Split Ring Lockwasher	14	.05

Changes Incorporated in Rotator Unit — Series 2

TRA-94-4	Motor with Potentiometer Mount	Omit	
TRA-94-5	Motor with Potentiometer Mount	Add	9.75

Purchase of Replacement Parts

An adequate stock of parts for the HAM rotor is maintained at our plant. These may be purchased directly at the listed prices or your dealer distributor will be glad to obtain them for you. Direct factory orders should be addressed: **CDR Rotor Parts Dept., 2070 Maple St., Des Plaines, Illinois.**

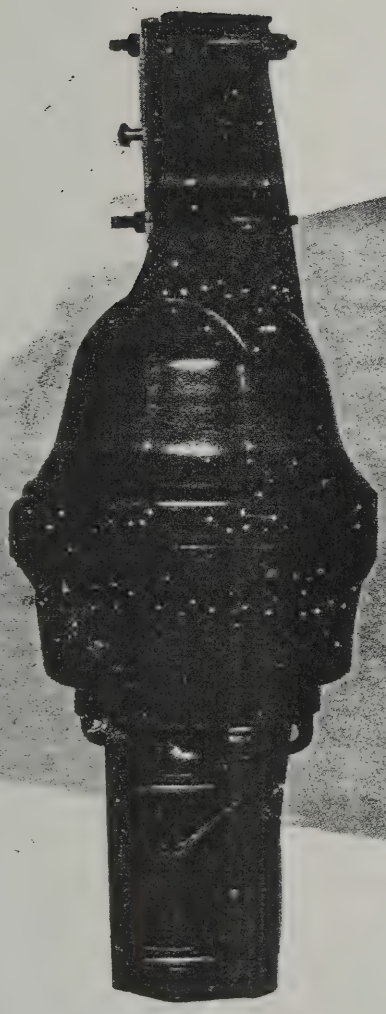
Please enclose check or Money Order to cover cost of parts and postage if unit is out of warranty. Requests for warranty replacement parts or service should be directed to the above, giving date of purchase, and a description of the trouble encountered. Authority to return merchandise must be cleared in advance of shipment.

Warranty

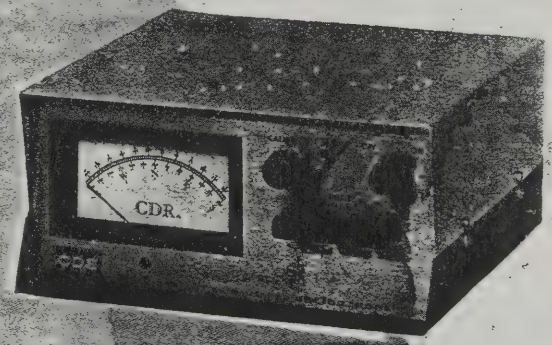
We warrant each new TR-44 rotor in accordance with E.I.A. Standards against defects of material or workmanship for a period of **three months** from the date the rotor is sold to the original purchaser, provided that the WARRANTY SLIP included in the manual has been properly filled out and returned as specified.

CLASS 252-50

CDE HAM II
ROTOR SYSTEM



Owner's Manual



THE HAM II IS RATED FOR ANTENNAS WITH UP TO 7.5 SQUARE FEET OF WIND SURFACE AREA.

CDE

CORNELL-DUBILIER ELECTRONICS
DIVISION OF FEDERAL PACIFIC ELECTRIC COMPANY
Rotor Department
Fuquay-Varina, North Carolina 27526

OWNER'S MANUAL - HAM II

Foreword

On the following pages, you will find information obtained from the Engineering Staff where the Ham Rotors are built, the Service Engineering Group, and from amateurs who have Ham Rotors installed. No attempt has been made to detail every possible installation or suggest every maintenance procedure that may be necessary to cover many years of operation.

Please feel free to communicate with us at any time that we may be of assistance. Write to:

CORNELL-DUBILIER ELECTRONICS
Division of Federal Pacific Electric Company
CDR Rotor Department
118 E. Jones Street
Fuquay-Varina, North Carolina 27526
919-552-2281

General

The Ham II Rotor System is designed to accomodate amateur antennas with a maximum of 7.5 square feet of wind area. The Ham II provides a full 360° range of rotation and a meter scale read out for accurate position indication.

The Ham II Rotator is built along the general lines of the original CDE Bell type rotors. The motor, radial and thrust bearings, electrically operated wedge brake, gear train, and indicating sensor are built into the elongated bell shaped cast aluminum housing.

The Ham II wedge brake system is operated independent of the clockwise and counterclockwise directional controls. However, the directional controls will not function until the brake is released.

Pre-Installation Check

It is recommended that a preliminary operational check be made on the system prior to actual installation. Check each item of the system for physical damage due to shipping. The Ham II system consists of a control unit, a bell rotator unit, a lower mast support, a hardware package and a service manual. If any of these items are missing or damaged, return the complete system to your dealer or the factory for replacement. Sales receipt must accompany such a return.

After the physical check of the equipment, set up the control unit and the Bell rotator for an electrical check. We recommend the following procedure:

1. Measure out the maximum 8-wire control cable required for your particular installation. (See spec table) strip the insulation from all wires, separate the individual wires back about 2-3 inches, and tightly twist the stranded ends. Soldering these ends improves manageability.
2. With the control unit and the rotator on the work table, connect the cable between the two units. Make sure wires 1, 2, 3, 4, 5, 6, 7, & 8 on the control unit are to 1, 2, 3, 4, 5, 6, 7, & 8 on the rotator, respectively.
   CAUTION: No loose strands of wire should touch adjacent terminals or other metal parts of the units.
3. With the rotator sitting in the upright position and connected to the control unit, by the eight (8) wire cable, plug the control unit power cord into a convenience 115 VAC 50/60 Hz wall socket.
4. Turn the power switch on. The meter should be illuminated.
5. Depress the brake release (center) lever then release it. An audible click should be heard in the rotator. This is the solenoid operating the wedge brake.
6. Depress the brake release, hold, and simultaneously depress the clockwise direction switch (right). The rotator should turn clockwise (looking from top). This is S-W-N-E-S. Release the direction switch; rotator will coast down and stop. Now release the brake. The rotator is now locked into position.

   CAUTION: It is best to release the direction switch, and brake switch prior to end of rotation (extreme clockwise or counterclockwise position) in order not to damage the stop arm and/or the gears.

The rotator is now stopped and the brake is engaged. To turn the rotator counterclockwise, release the brake, hold and simultaneously depress the counterclockwise switch (left). The rotator will turn counterclockwise. This is S-E-N-W-S. After rotator has stopped, release the brake.

Prior to actual installation, check the calibration to familiarize yourself with this procedure. It is best done while the system is still set up for the Pre-installation check.

In Service Operation

The Ham II brake release feature is specifically designed to decrease the effects of torsional forces caused by rapid de-acceleration and instant stopping of large antennas and beams. With practice, smooth and precise stops can be made without overstressing the rotator, tower, antenna or supporting mechanisms. By releasing the direction control switch slightly before the point of intended antenna position, letting the unit coast to a full stop, then releasing the brake, no snap action stops are required. This feature of the Ham II, when properly used, should prolong the life of your rotor system as the major stresses are greatly decreased.

Service

Cornell-Dubilier maintains a modern well staffed repair department for all CDE antenna rotors. If service is required, the unit should be packed securely and sent prepaid to:

Cornell-Dubilier Electronics
Rotor Service Department
118 East Jones Street
Fuquay-Varina, N. C. 27526

For units that are in warranty, no charge will be made for repair. If the unit is out of warranty, the following flat rate charges apply:

Control box only	$ 23.00
Rotator only	25.00
Complete unit	$ 36.00

A check or money order for the amount indicated above should be included. The flat rate charge includes rebuilding the unit and replacing of defective parts. Prices subject to change without notice.

Meter Calibration

Rotators are shipped from the factory stopped in the full counter clockwise (South) position. To calibrate the meter, have the rotator full counter clockwise position, on - off switch "off" and use the zero - center screw to line the needle on the left hand "S" limit. With the on - off switch in the "on" position, push in the calibrate knob. The calibrate knob is a push to calibrate type. (Some models: Push, hold in, calibrate, release. Other models, push, release, calibrate, push again to disengage calibrate circuit.) Locate the needle on the right hand "S" limit. This meter calibration can be performed any time it is desired to check the accuracy. When power is off, the needle will fall to the left hand "S". When power is on, the needle will indicate the antenna position. The zener regulated meter supply will minimize reading variations due to line voltage fluctuations.

Rotor Installation The Ham II rotor is engineered to handle relatively heavy antennas including multi-band arrays having traps at the extreme of the elements. Long and trouble free performance of the system depends on making the installation to properly handle the stresses involved. **CAUTION:** THE ROTATOR IS DESIGNED FOR VERTICAL OPERATION WITH THE BELL SHAPED HOUSING IN THE UP POSITION. Water and other contamination will get into the motor unit if mounted horizontal or up-side-down.

Balanced Weight produces only down-thrust on the rotor. With 98 ball bearings operating in accurately machined races, the rotor is capable of handling as much as a thousand pounds downward pressure in line with the axis of rotation.

Unbalanced Weight creates a bending moment of force which is concentrated on the mast at the point where it is clamped to the top of the rotor. This moment tends to strain the mast at that point and also to bind the ball bearings by creating excessive downward pressure on one side and upward pressure on the other. Such unbalance places additional stresses on the motor and gear train. Unbalanced weight becomes critical as the distance from the antenna boom to the clamping point at the rotor is increased.

Wind Pressure against the boom and elements usually produces a bending force on the mast which causes the same stresses as unbalanced weight. To strengthen the installation to withstand unbalanced weight and wind pressure, the top mast should be as short as possible. In multiple arrays the heaviest sections should be closest to the rotator. In order to distribute the binding stress and prevent fracture of the mast, the HAM rotor includes two long, heavy, specially designed steel clamping plates. These are grooved to grip the mast securely. It is recommended that the mast be reinforced in the area where it is clamped by driving a hardwood dowel of proper size into the end of the mast.

Start-Stop Torsion Torsional or twisting forces must be given special considerations when using the Ham rotor with large antennas and beams. The acceleration of the antenna array is gradual as the motor picks up the load. However, if the brake release switch is not used properly, stopping will be instantaneous, therefore, subjecting the antenna, rotator, and support system to undue strain. To alleviate instantaneous stops, always release the directional switch, CW or CCW, prior to the intended antenna direction, let the unit coast down to a stop, then release the brake. When the brake wedge is engaged into the groove of the outer casting, the top and bottom of the masts are locked rigidly together. It is absolutely essential that all mechanical assemblies making up the antenna array be solidly clamped so that no slipping occurs under heavy stop/start/wind load conditions.

Torsional Guying of Tower Average height, well built towers, properly erected, carrying average antennas, are able to absorb the heavy twisting strain at the moment of stopping. Where the antenna is large or heavy, or the tower is tall or of light weight construction, a torsion bar or sway brace (as shown in Fig. 2 on the next page) should be rigidly attached near the top of the tower. Such an arrangement allows the double guy wires to absorb the shock of stopping, which would otherwise tend only to twist the tower on its base.

Mechanical Description The motor drives a train of stainless steel spur and pinion speed reduction gears which in turn drive the ring gear. The ring gear drives the bell shaped upper mast support, into which the antenna mast is mounted in rigid central alignment.

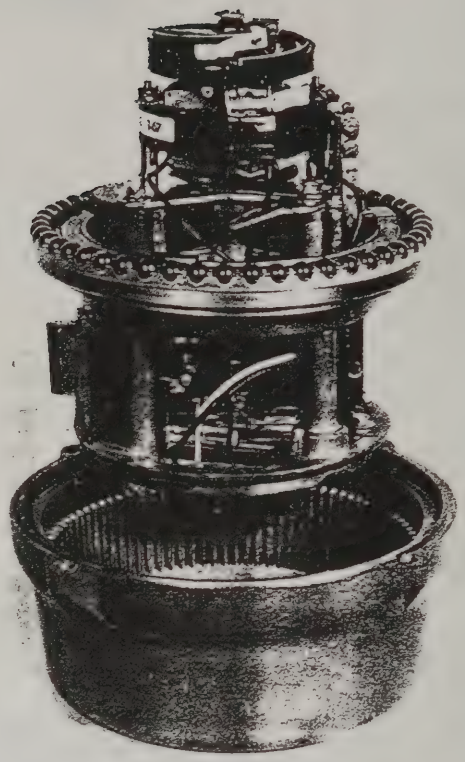


Fig. 1

A boss is cast on the under side and in the center of the cavity of the upper mast support, which engages the serrated edge of the potentiometer arm which is mounted on the top of the inner mechanism.

Maximum support and low frictional loss between the rotating upper mast support and the inner mechanism is assured by the use of two groups of 49 steel balls each riding in the bearing races between the two assemblies, and held in special nylon retainers.

Mechanical stops along with electrical limit switches are built into the rotor mechanism to provide accurate and complete 360 degree rotation.

The brake assembly is released by a 24 volt AC solenoid, the plunger of which is mechanically attached to the wedge. When the wedge is positioned for braking, a cam latch locks the wedge in the teeth of the lower housing. To release the brake, the solenoid is energized. This unlocks the latch automatically and retracts the wedge from the gear teeth in the housing.

Circuit Description Two transformers are mounted in the control unit. The power transformer supplies approximately 30 VAC for releasing the brake and operating the motor when control levers are depressed. Overheating of the transformer from prolonged operation or possible short circuit is prevented by a thermal cut-out switch in the primary winding.

The motor is a two-phase device with the first winding being supplied AC direct from the transformer while the second has a 120-140 MFD. capacitor in series in order to shift the phase and provide forward rotational torque. To reverse, the capacitor is switched in series with the first winding, while the second is directly supplied from the transformer.

The solenoid which releases the brake operates from the same transformer that supplies power to the motor.

The meter transformer is energized as the on-off control is switched to the "on" position. This illuminates the meter dial

and the meter indicates the position of the antenna. 13 VDC is supplied to the 500 OHM potentiometer in the rotator through a zener regulated supply.

The meter is a high quality DC instrument requiring 1 MA for full scale deflection. It is connected with plus side through the 10 K multiplier to the plus side of supply and potentiometer, which is protected by a ⅛ AMP fast blow fuse. The meter circuit is completed through the 5000 OHM calibrate control and operate/calibrate switch to ground. The operate/calibrate control is located on front panel. With the zener controlled supply the 5K calibrate control will be set at approximately 3000 OHMS which will give 13,000 OHMS in series with meter to allow for 1 MA deflection at full scale.

Two electrical limit switches in the rotator cut the motor power just before the rotation reaches the extremes. A fuse, located on rear panel is also included on one side of the AC power line.

CONSTRUCTION NOTES

A. Tape cables securely to mast.
B. Provide slack for rotation and drip loop.
C. Anchor securely to standoff to prevent strain on connectors and slipping of cable.

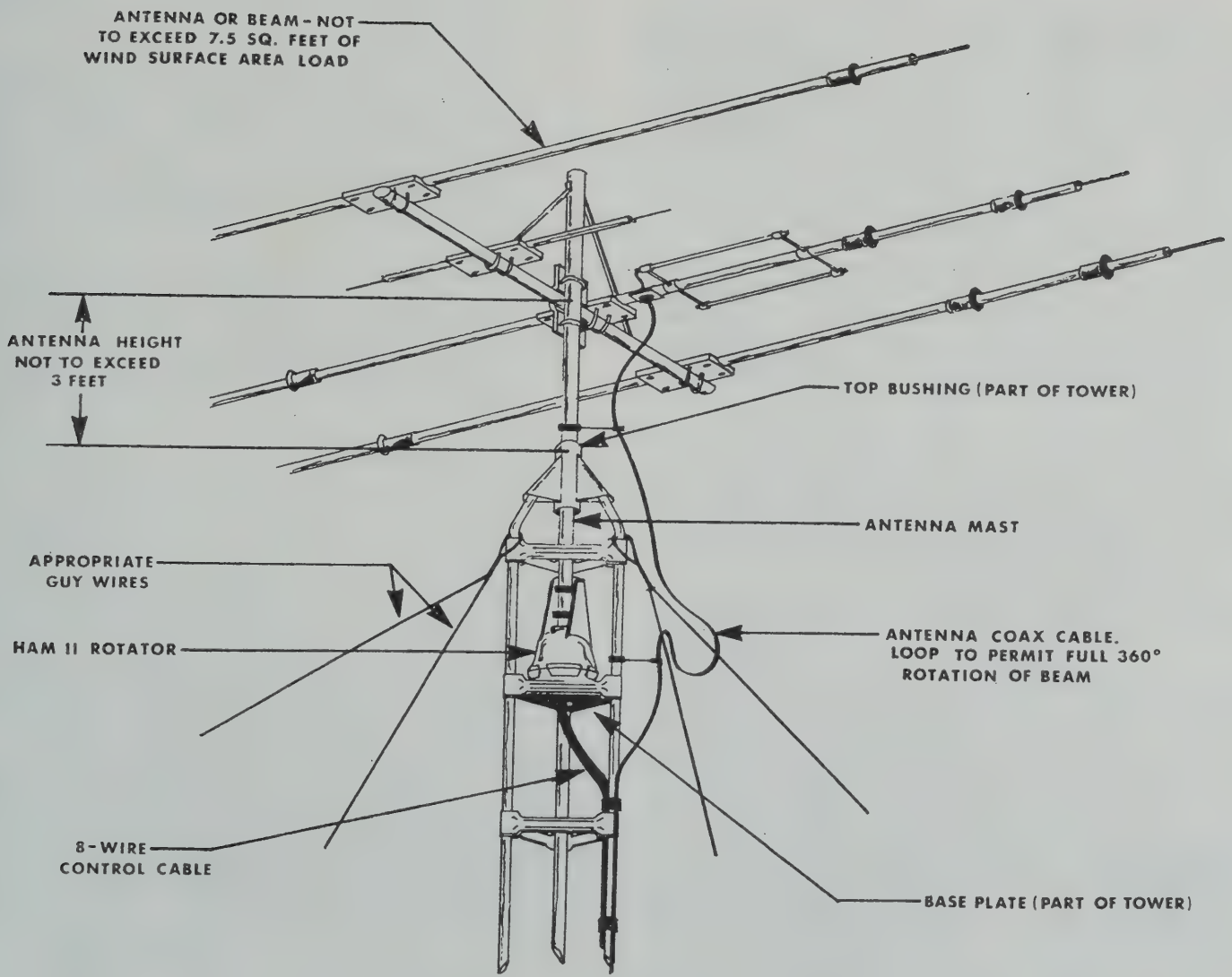


Fig. 2 — INSTALLATION

Checking Control Unit

To check the control unit, plug line cord into 115 volt AC power. With no connections to terminals turn the on-off switch to on position, the meter light will illuminate. Meter needle will remain on left hand "S".

To check the power circuit connect an AC voltmeter between terminals No. 1 and No. 2 on the rear panel and see that approximately 30 volts is indicated when brake release lever is depressed. Connect meter leads between terminals No. 1 and No. 5 and read approximately 30 volts with brake release lever and clockwise lever depressed. Now connect meter leads between terminals No. 1 and No. 6 and read approximately 30 volts with brake release lever and counterclockwise lever depressed.

Checking Rotator

Connect all 8 terminals of the control box to the corresponding 8 terminals of the rotor using the coil of cable obtained for the installation. The 2 heavy wires in the cable should be used for terminals 1 and 2 (Refer to Schematic). CAUTION — SHORTS BETWEEN TERMINALS OR GROUNDED LEADS MAY BURN UP THE POT STRIP IN ROTATOR.

With the rotor in an upright position without the lower mast support assembled, operate rotator by means of control unit lever in both directions. The operation of control unit lever on and off, releases the brake mechanism in rotator. This is audible to the operator.

Checking Rotator From the Ground

One may possibly avoid bringing the rotator down from the mast by making electrical checks from the position of the control box. This is done by disconnecting the eight wires from the screw terminals and tagging them carefully No. 1 through No. 8 to correspond with the terminal numbers from which they are removed. From the schematic diagram it is apparent that the resistance of the lead wires will be added to the resistance of the motor windings and potentiometer strip in making the resistance checks.

Leads No. 1 and No. 2 of No. 18 AWG have approximately 0.64 OHM resistance per 100 feet and leads No. 3 through No. 8 of No. 22 AWG have approximately 1.6 OHMS resistance per 100 feet. Use a low resistance ohmmeter to check the values shown in table one to an accuracy of 10 percent after adding the resistance of the leads involved.

To Check	Read Resistance	Between Terminsl
Brake Solenoid	.75 ohms + leads	1-2
½ Motor Winding	2.5 ohms + leads	1-8
½ Motor Winding	2.5 ohms + leads	1-4
½ Motor + Switch	2.5 ohms + leads	1-5
½ Motor + Switch	2.5 ohms + leads	1-6
Entire Motor	5 ohms + leads	8-4
Right Limit Switch	0 ohms + leads	8-5
Left Limit Switch	0 ohms + leads	4-6
Entire Pot Switch	500 ohms	3-7
Pot Arm to + End	0 to 500 ohms	3-1
Pot Arm to — End	0 to 500 ohms	1-7

Table 1

Servicing the Control Unit

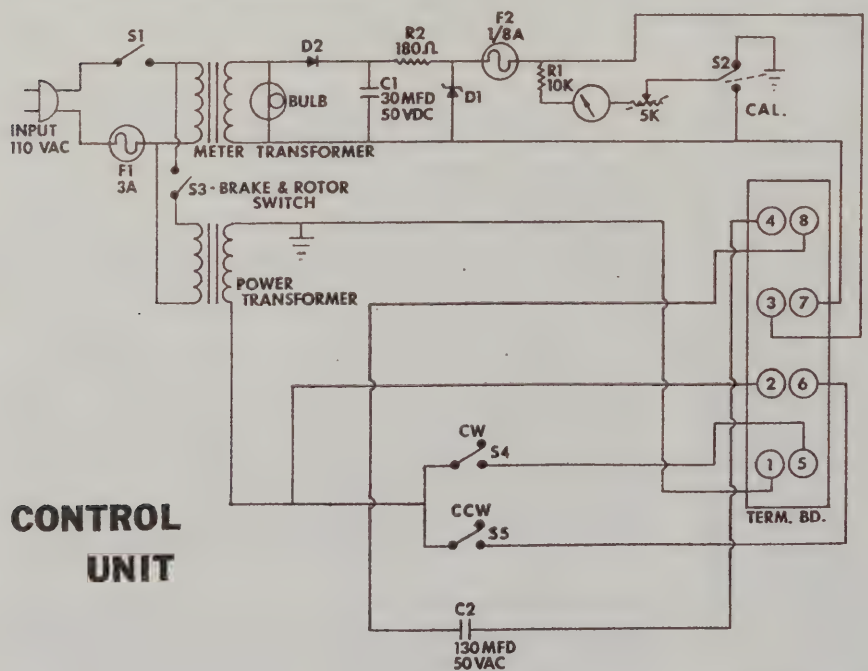
Disconnect the AC power source and remove the eight wire control cable. Be sure to tag each wire with the corresponding terminal number.

The control box can be checked without removing the cover by using a volt-ohmeter to check values across terminals. Resistance across terminals No. 1-2 should read .4 Ohms. Read same value across terminals No. 1-5 with clockwise switch lever (right-hand) depressed and across terminals No. 1-6 with counter clockwise switch lever (left-hand) depressed. Resistance across input line cord with on-off switch in the "on" position and the brake lever depressed should read 3.8 Ohms.

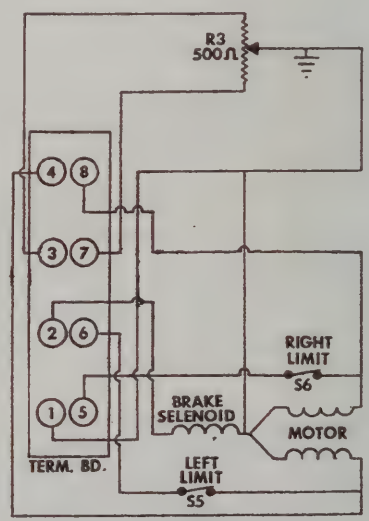
With power cord connected and on-off switch in the "on" position and brake release lever depressed read approximately 30 VAC across terminals No. 1-2. With on-off switch in "on" position read 13 ± 10% VDC across terminals No. 3-7.

The electrolytic motor capacitor must be of proper value to give adequate motor torque. If a new capacitor is not available for check by substitution, a quite reliable check may be made using the power transformer in the control box and an auxiliary 1 Ohm 10 Watt resistor.

To make this capacitor check, remove cable from terminals and tie terminal No. 2 to No. 4. Connect one end of resistor to No. 1 and the other end to No. 8. Turn off-on switch to "on" position and depress brake release lever. If capacitor is ok it will draw sufficient current to cause a voltage drop of 1.4 to 1.6 volts to be present across the resistor. Measure with an AC voltmeter.



CONTROL UNIT



ROTATOR UNIT

NOTE: USE # 18 WIRES FOR TERMINALS 1 & 2.

Fig 3

Disassembly of Rotator

1. Remove the bottom mast support to permit the rotator to be set on a flat bench.
2. Remove four screws and carefully raise top casting to expose potentiometer and drive mechanism.
3. Carefully remove upper ball retaining ring. Keep it circular, and lay it on clean paper.
4. Inspect inside of top housing for small scratches or burned spots on the ribs. These are an indication that a switch blade or connection is rubbing during rotation. See that the pot strip is clean and not burned at either end. See that pot body is secure and that pot arm is clean at the point of contact. Use only fine rouge cloth to polish contact arm. Check limit switch to see if wires are secure and insulation is undamaged. Contacts should be clean. Check for 1/32" clearence between switch blades and motor—particularly alongside of lockwasher under motor fastening. Greater clearance gets switch too close to top bell housing ribs.
5. If the drive ring happens to be near end of rotation, operate the top spur gear to rotate the mechanical stop on the drive ring away from the area of the limit switch. See that the mechanical stop lever (which is positoned between the two limit switches) will open each electrical contact before it hits the corresponding mechanical stop. Also see that the stop lever has not been deformed and that the electrical contacts are clean and uncorroded.
6. Rotate the top spur gear several revolutions to determine that the motor and its bearings are operating freely. Look for broken teeth in any of the gears.
7. Lift the motor and brake mechanism out of the brake housing. Carefully remove the lower ball bearing retainer and place it on a clean piece of paper.
8. Remove the drive ring gear from the base housing. This is accomplished by first pulling up on the side opposite the gear train. Then raise the entire ring slightly upward with the side away from the gear train higher so that it will slide out from the under the gears. Examine closely for evidence of broken or worn teeth.
9. Examine the inside of the screw terminal strip to see that there is proper clearance between the solid lugs and frame and that there are no faults in the insulation. Pay particular attention to the insulation at the point where the wires are held in metal clips.
10. Examine the teeth in the brake casting.
11. To separate motor, pot, and gear assembly from the brake assembly, unsolder the solenoid leads from terminals 1 and 2. Remove screws holding terminal board to casting. Then remove four large screws in the base. Be careful to clear wires and terminal strip through opening.
12. The latch mechanism, accessible only after step 11 disassembly, slides down into grooves in the casting and provides the top bearing surface for the brake wedge. The latch itself, which is held down by the compression springs, should prevent the brake wedge from being pushed into the casting from the outside. When the plunger is pushed into the solenoid by pressure applied on the latch pin, where the retracting springs are attached, the wedge is withdrawn and may then be pushed clear into the casting.
13. To remove potentiometer, pry the spring fasteners with a sharp instrument. Remove hex nuts. Unsolder leads. Mounting studs are welded to the motor frame. Be sure that the pot strip is clean and that pot arm is not corroded. Use only fine rouge cloth as an abrasive. In replacing the pot be sure the connections are on the side which overhangs the motor.
14. To replace the motor, first remove the pot per Paragraph 13, then unsolder black motor lead from screw terminal 1, the red lead from inside left limit switch lug, and the blue lead from inside right limit switch lug. Fastenings holding motor on studs may then be removed and the motor pulled up and out. In replacing a motor, be sure to see that the round hole in the motor is next to the limit switch. Use a double lock nut on this stud near the limit switch, to provide clearance with the leads. Use special internal-external lockwasher over the stud that works in the slotted hole in the motor. Be sure that the pinion is snug against the spur gear before tightening this fastening over the slot.
15. When it is necessary to closely inspect or replace gears, it is possible to remove motor, limit switch, pot, and terminal strip without unsoldering more than the solenoid leads from terminals 1 and 2. Remove motor fastenings from the mounting studs. Work motor up and out, exercising care in pulling leads and terminal strip through the window in the gear housing. Remove plate to expose gears. Carefully note positions for proper replacement.

Final Reassembly of Rotator

It is assumed in the following instructions that the brake mechanism is assembled and operative. The motor and gear train along with potentiometer and limit switch are likewise assembled and wired and operative.
It is not likely that the brake wedge will be exactly positioned in relation to the teeth in the brake housing to permit proper assembly unless the brake mechanism is retracted. For this reason it is necessary to operate the brake mechanism electrically during step 8 of the assembly of the rotator unit.

1. See that a small amount of low temperature, high quality, light weight grease is conservatively distributed around the ball bearings, ring gear, and spur gears. Only an even film of grease is desirable (approximately one thimbleful of grease should be used to lubricate a completely dry rotator). Excessive grease will only run out in high temperatures or cause power loss in low temperatures. A few drops of light weight No. 10 lubricating oil should be applied to the motor bearings.
2. Rotate upper spur gear until the inwardly protruding mechanical stop on the ring gear engages the channel shaped stop lever and pushes it far enough to the right to just open the right hand limit switch contact (it is assumed that the rotator is viewed from the side of the limit switch). This situation represents the extreme counterclockwise end of rotation. The potentiometer arm must then be rotated to its extreme counterclockwise position against the top brass stop.
3. Secure the upper bell housing upside down by the mast support in a vise with the open end of the "V" toward the bench. The boss which drives the potentiometer arm which is located in the bottom part of the ball housing will then be to the left of center.
4. Clean the inner portion of the housing and apply a small amount of grease to the ball race. Then carefully insert one ball bearing assembly with the flanged rim up and against the outer edge of the casting.
5. Grasp the operating mechanism by the flat base, steady the ring gear, invert the mechanism and lower it into the housing. In doing this, note that the serrated portion of the potentiometer arm must engage the driving boss in the housing and that the three driving lugs on the ring gear must engage the mating lugs in the top housing. This situation will result automatically if the previous instructions have been followed.

6. Determine that the top bearing surface is clean and apply a film of grease on the top ball race and the top bearing assembly. Then apply the top bearing assembly to the race with the rim downward.
7. Clean the brake housing and apply a light film of grease to the ball race only. Lower the brake housing into place so that the assembly holes will approximately line up with the threaded holes in the upper housing. DO NOT MECHANICALLY FORCE AN EXACT ALIGNMENT OF THESE HOLES WITHOUT ELECTRICALLY RELEASING THE BRAKE MECHANISM.
8. Connect the control terminals No. 1 and No. 2 only to the corresponding terminals on the rotator while it remains clamped in the vise. Momentarily operate the lever on the control box to retract the brake. This will permit the brake housing to be freely rotated for exact alignment of the holes. With the power applied to the brake, insert the 4 assembly screws and run them down to a reasonably tight position. Keep the brake retracted electrically while all 4 screws are being tightened. Release the brake electrically and use a heavy screwdriver with wrench to completely tighten the 4 assembly screws. Torque to 85 inch pounds.
9. It is suggested that all 8 wires be connected from the control box while the rotor is still on the bench and that its complete operation be checked.

TROUBLE SHOOTING SUGGESTIONS

Field experience has shown that most operational difficulties with the HAM rotor are traceable to broken, shorted, or grounded wires—usually at the terminal strips. Time spent in cutting the leads to exact lengths, tinning, forming, and wrapping around terminals, cutting insulation to exact length, and clamping to prevent strain on any single wire, will pay big dividends later in long and trouble-free performance. Put it up right—and leave it up!

Should trouble occur, first follow the suggestion on Page 5 for "Service Control Unit" and "Checking Rotor From Ground". Compare resistance values with Schematic Diagram to localize trouble. The following "symptoms" and "treatments" may also be helpful.

Mechanical Play To prevent binding under adverse operating conditions, a small amount of play is designed into the rotor. Even a degree or so of rotary play will permit several inches movement at the end of a wide antenna boom, or at the tips of the elements. Frequently the slight motion of the antenna array in gusts of wind is due more to the natural flexing of the elements and masts than it is due to actual play in the rotor mechanism.

Antenna Rotates in Heavy Wind This is usually a matter of the mast slipping in the support. For large arrays it is often necessary to drill a ⅜" hole through clamping plate, mast and mast supports and pin them together with a non-corrosive fastening. A false indication of suspected "slipping" can be obtained by comparing meter readings at different times when the beam has not been "rotated officially". If the rotor is actually turning, the brake latch is not engaging properly. Since it is pulled into place by springs and only retracted electrically, it will be necessary to disassemble the rotor per instructions on page 6 and follow suggestions of step 12 regarding the latch mechanism.

Lack of Power so that antenna rotation is slow or sluggish. Be sure that the heavy leads in the cable were used for Terminals No. 1 and No. 2, as these leads must carry about 5 amps. to handle power for both the brake and motor. Use method on page 5 to check motor from ground. Check the capacitor. Check transformer for AC output. If the electrical circuit is OK, then check for mechanical binding. Pay particular attention to bearings and alignment of shaft on an inside tower mount. As a last resort, dismantle the rotor to check gears, bearings, etc.

No Meter Indication The brake and motor operate independent of the indicating system. If the pilot lights burn at proper brilliancy, the instrument transformer is OK and output is not shorted. Check for about 21 VDC across terminals No. 3 and No. 7 with switch operated. If this is present, check for 500 ohms across these leads to rotor (disconnected at control box). If 500 ohms is present from No. 3 and No. 7, see if the readings from No. 3 to ground and No. 7 to ground total 500 ohms. If this is so, connect an auxiliary meter from terminal No. 3 to ground and see that voltage runs from zero to about 12 volts as antenna is rotated from left to right extremes.

No Rotation — Indication OK Either the thermal cutout in the power transformer has opened to protect the motor or capacitor from excessive heat of prolonged operation or there is actually trouble on the motor circuit. After allowing time for the thermal cutout to restore service, proceed with suggestions above for "lack of power".

Grounded Leads Grounds on cable leads will burn out either the line fuses or the small fuse in the DC circuit. For full explanations, refer to Schematic. If lead No. 3 is grounded, it shorts out part of the pot, so that as rotation progresses to the other end, the full DC voltage is applied across a decreasing portion until current becomes so high that it burns out. Note also that any grounds either put an overload on the power transformer which causes the line fuse to blow, or overload the rectifier circuit so that the ⅛ amp fuse blows.

Meter Fluctuation An intermittent condition in any component in the rectifier or meter circuits within the control box, as well as in the cable or potentiometer circuit in the rotator itself can cause meter fluctuation or error. Possible causes of such trouble may be localized by placing a test DC meter across terminals No. 3 and No. 7 and comparing the action of the test meter with the panel meter.

If the test meter fluctuates along with the panel meter, either a component in the rectifier circuit is intermittently defective, or an intermittent trouble-ground is drawing excessive current. To further localize such a condition, leave the test meter on terminals No. 3-No. 7 and remove the corresponding leads to the rotator. This removes the load from the DC circuit so the test meter will show about 12 volts. The panel meter sensitivity will be cut about in half, so it will show about ¾ scale. Fluctuation of the test panel meters will now point to trouble in the DC rectifier circuit. Fluctuation of panel meter only, will point to intermittent trouble in the meter, multiplier resistors, or the "cal." pot.

Where the meters are steady in preceding tests, and there is fluctuation with rotator leads connected, it indicates trouble in the lead wires or rotator itself. The resultant fluctuations usually cause the meter to pulse UPWARD from a given reading. Any dirt, grease or corrosion that breaks or interferes with the ground return from the potentiometer slide will cause the needle to fluctuate from a true reading toward a center scale point. In such cases it is necessary to open the rotator per instructions on page six.

The ground connection is carried through the potentiometer pivot directly to the frame.

PARTS AND PRICE LIST

CONTROL UNIT
HAM - II/CD-44

50940-10 Control Unit, Complete (115 VAC)

PART NUMBER	DESCRIPTION	Quantity	$89.95 Price Each
	ELECTRICAL		
10344-03	Fuse, 3 Amp, F-1	1	.30
10733-01*	Transformer, Power 115 VAC-Std on 50940-00	1	14.50
30112-05	Switch, Micro S-3, S-4, & S-5	3	1.60
51172-00	Capacitor (120-140 Mfd.) C-2	1	2.50
50153-00	Diode, Zener, D-1	1	4.50
50177-00*	Transformer, Meter 115 VAC-Std. on 50940-00	1	7.00
50183-00	Capacitor (30 MFD) C-1	1	1.30
50501-00	Diode, 100 Piv. D-2	1	1.00
50513-11	Resistor (10K Ohms 1/2W) R-1	1	.35
50513-12	Resistor (180 Ohms 1W) R-2	1	.35
50563-00	Fuse, ⅛ Amp., F-2	1	.30
50861-00	Line Cord, 3 Wire	1	2.00
50883-00	Meter, Lamp Holder, and Bezel ("N" Center)	1	23.10
50895-00	Bulb, Meter	1	.90
50899-00	Switch, On-Off, S-1	1	2.00
50900-00	Switch, Calibration, S-2	1	5.60
	SHEET METAL AND HARDWARE		
10555-00	Strip, Solder Terminal	1	.50
10563-00	Holder, Fuse, F-1	1	1.90
30362-05	Spring, Extension (Meter Bezel)	2	.30
50185-00	Holder, Fuse, F-2	1	.60
50187-00	Knob, Switch	2	1.00
50194-00	Clamp, Cable	1	.20
50300-00	Bumper, Rubber	4	.15
50399-00	Strip, Terminal (8 Pin)	1	.70
50884-00	Lever, Switch (Direction & Brake)	3	.60
50885-00	Cover, Top (Tan)	1	4.00
50886-00	Cover, Bottom (Brown)	1	4.50
50890-00	Face Plate	1	3.10
50891-00	Chassis	1	6.00

*Note: 115 VAC control unit can be converted to 220 VAC by installation of the 220 VAC power and meter transformers.

10735 - 01 Transformer, Power, 220 VAC
50202 - 00 Transformer, Meter, 220 VAC

To order parts, remit check or money order for total parts cost plus $1.00 for postage and handling to: Cornell-Dubilier Electronics, Department "C", 118 E. Jones Street, Fuquay - Varina, N. C. 27526

Prices subject to change without notice. CDE reserves the right to change prices at its option. Current prices may be obtained by calling or writing the factory. Please send self addressed stamped envelope.

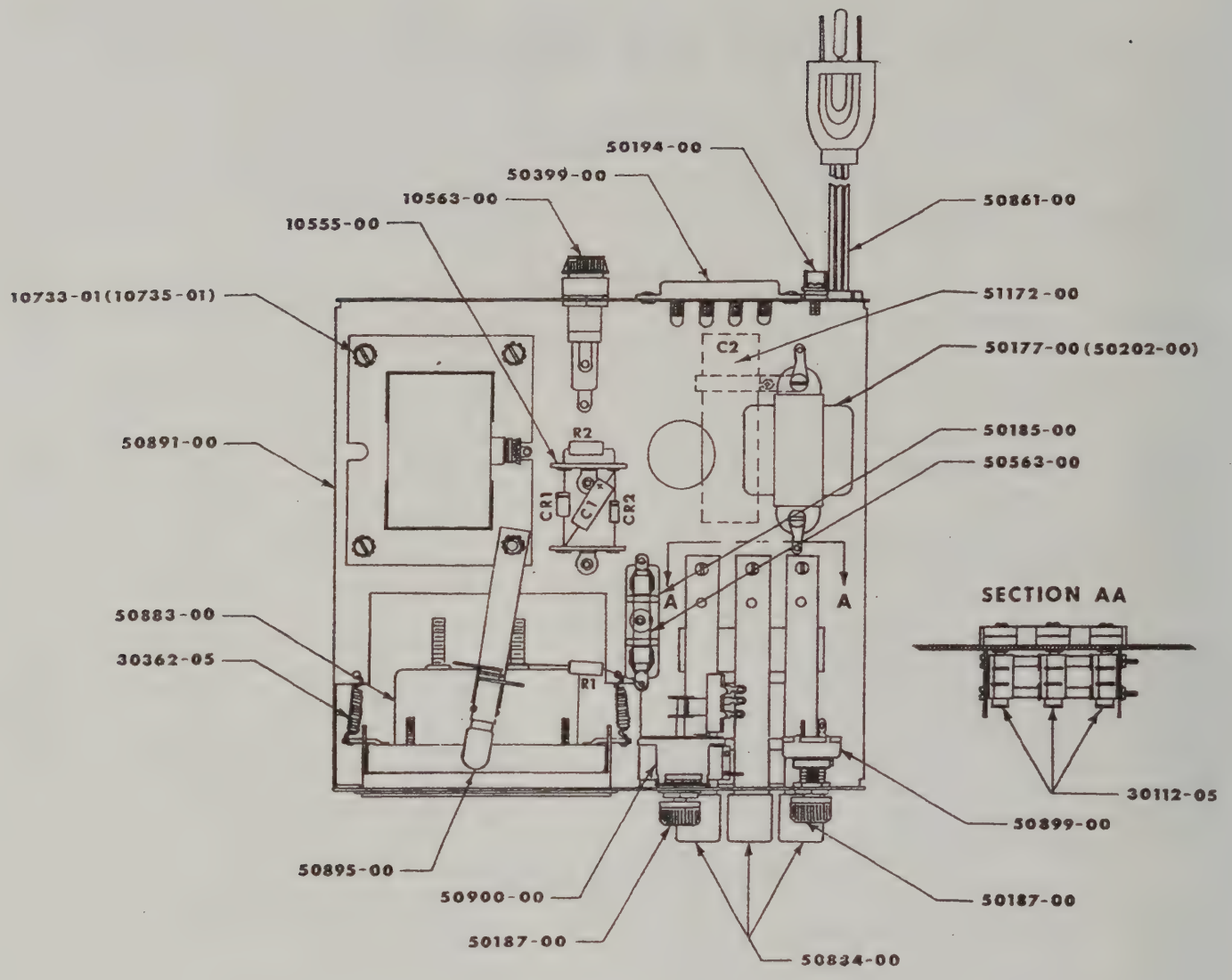


Fig. 4

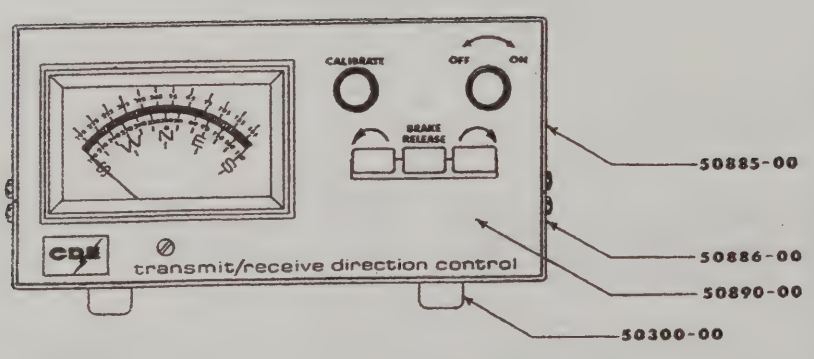


Fig. 5

LIMITED WARRANTY

CORNELL-DUBILIER ELECTRIC CORPORATION (CDE) warrants that your new ROTOR has been manufactured free of defects in design, material and workmanship. If this product fails to give satisfactory service due to defects covered by warranty, including any warranty implied by law such as WARRANTIES OF MERCHANTABILITY OR FITNESS, for a period of ONE YEAR FROM THE DATE OF PURCHASE, CDE will, at its option, replace or repair the unit, or any defective part free of charge.

To obtain warranty service, return the ROTOR to your dealer, or pack it securely, and send it with proof of purchase date and a letter explaining the problem, shipping cost prepaid, to: CORNELL-DUBILIER ELECTRIC CORPORATION, WARRANTY REPAIR DEPARTMENT, 118 E. JONES ST., FUQUAY-VARINA, N.C. 27526.

IMPORTANT

Warranty service covers repair or replacement of the ROTOR only. CDE is not responsible for costs of removal or reinstallation, or shipping to the place of repair. The warranty period is not extended due to repair or replacement.

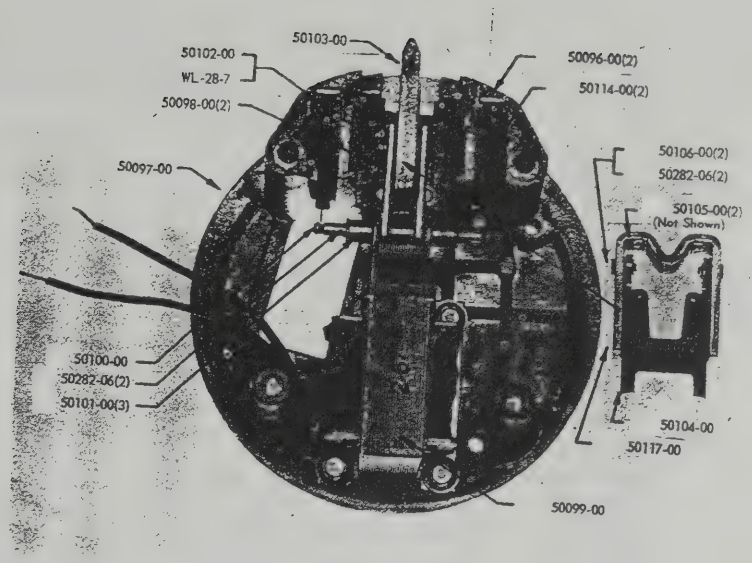
CDE reserves the right to make reasonable charges for service if there is evidence of damage due to alteration, misuse or installation not according to the enclosed instructions.

CDE IS NOT RESPONSIBLE FOR DAMAGE TO OTHER EQUIPMENT OR PROPERTY OR FOR ANY OTHER CONSEQUENTIAL OR INCIDENTAL DAMAGES OF ANY KIND, WHETHER BASED ON CONTRACT, NEGLIGENCE OR STRICT LIABILITY. MAXIMUM LIABILITY SHALL NOT, IN ANY CASE, EXCEED THE PURCHASE PRICE OF THE UNIT.

(Some states do not allow limitations on how long an implied warranty lasts, or the exclusion or limitation of incidental or consequential damages, so the above limitations and exclusion may not apply to you.)

(This warranty gives you specific legal rights. You may also have other rights which may vary from state to state.)

Fig. 6



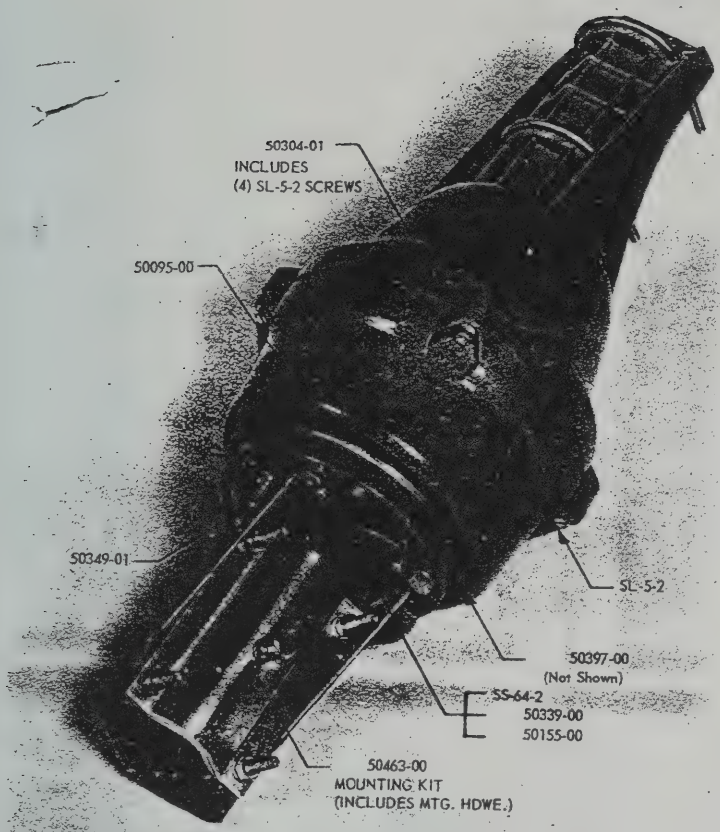


Fig. 8

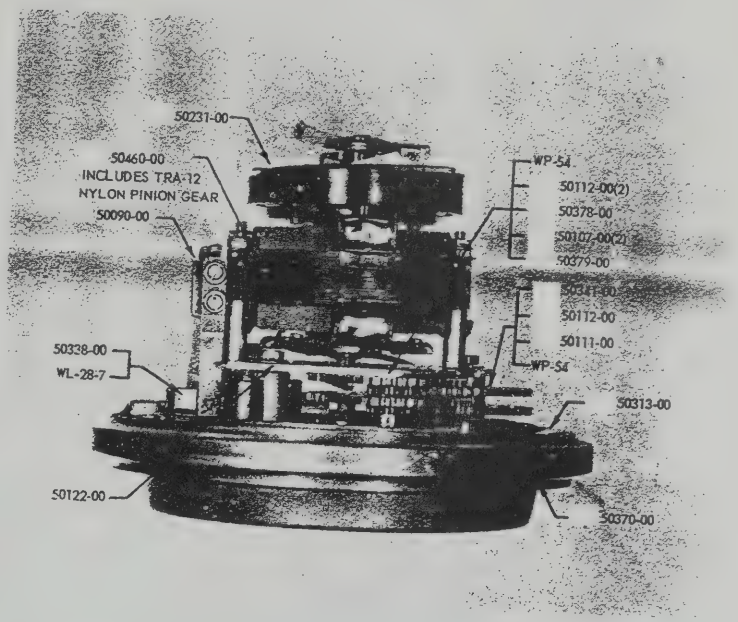


Fig. 7

ACCESSORY KITS

ALTERNATE METER SCALE

50924 - 10 South Center Meter Scale Kit 3.00

SOUTH CENTER SCALE KIT

The stock Ham II/CD-44 control unit is produced with a North Centered meterscale. Since some locations and/or popular working areas may favor rotation stops at North, we provide a South Centered meter scale kit for field modification.

INSIDE TOWER MOUNTS

50559 - 10 Tower Spacing Plate Kit 4.50

The tower mounting plate kit is a flat plate equipped with four .5 inch standoff bushings drilled to match the hold down screw holes in the bottom of a CDE Bell type rotator. The plate essentially is designed to allow enough clearance under the bottom of the rotator to permit the rotator to turn without touching the 8-wire control cable.

On any inside tower installation, care must be exercised to get the top mast shimmed to the exact rotational center of the rotator upper mast support. The geometry is such that a mast of 52 mm (2.062 inches) will be exactly centered. For each 1.6 mm(.0625 inches) less mast diameter used, .8 mm (.031 inches) of shim must be wrapped around the mast at the clamping points.

PARTS AND PRICE LIST

HAM-II ROTATOR

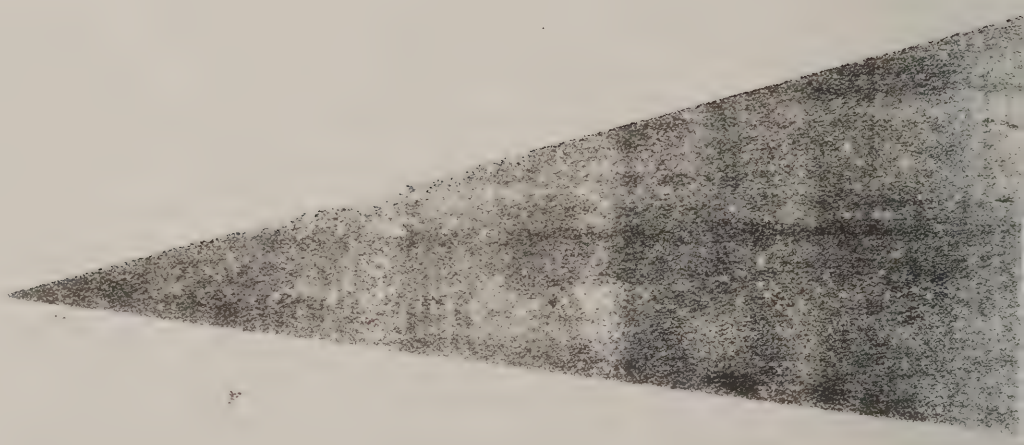
PART NO.	DESCRIPTION	QUANTITY	PRICE EACH
50232-00	Rotator Unit Complete	1	$83.95
50349-01	Lower Mast Support Assy.	1	5.00
50339-00	Terminal Cover Plate for Lower Mast	1	.50
50155-00	Grommet for Terminal Cover	1	.18
50304--01	Upper Mast Support (Bell Casting)	1	7.50
50095-00	Brake Housing (Lower Casting)	1	8.00
50335-01	Ball Bearings	98	.12
50113-00	Ball Retainers	2	1.10
50097-00	Brake Support Casting	1	6.25
50370-00	Base Casting & Gear Shaft Assy.	1	5.10
50310-00	Motor Pinion (Nylon)	1	.50
50112-00	Gear and Pinion (1st, 2nd, and 3rd from Motor)	3	4.50
50111-00	Gear and Pinion (Thick pinion 4th from Motor)	1	5.25
50107-00	Final Spur Gear	2	2.40
50313-00	Ring Gear (Cast Aluminum)	1	2.50
50341-00	Small Gear Spacer (Brass)	1	.30
50378-00	Large Gear Spacer (Steel)	1	.40
50379-00	Bushing for Final Spur Gear	1	.40
50460-00	Motor & Pinion Assy.	1	18.10
50122-00	Motor Mounting Plate with Studs	1	2.50
50231-00	Potentiometer Assembly (Complete)	1	9.60
50090-00	End of Rotation Switch Assembly (Complete)	1	3.30
50338-00	Stop Lever Assembly	1	1.00
50099-00	Solenoid Only	1	9.10
50100-00	Solenoid Pin	1	.40
50101-00	Solenoid Pin Spacers	3	.30
50282-06	Solenoid Pin RetainingRing	2	.15
50114-00	Solenoid Retracting Springs	2	.25
50096-00	Retracting Spring Clip	2	.15
50103-00	Brake Wedge	1	4.40
50098-00	Connecting Links	2	.50
50102-00	Connecting Link Pin	1	.35
50117-00	Brake Wedge Support	1	.95
50104-00	Brake Latch	1	1.00
50106-00	Latch Pins	2	.25
50282-04	Latch Pin Retainers	2	.15
50105-00	Latch Springs	2	.25
50399-00	Terminal Board Assembly (8 Terminals)	1	.70
51234-00	Retainer for Stop Lever Assembly	3	.15
51120-00	Washers	3	.10
02-06006-061	Self-Tap Screw 6-32x⅜	2	.10
51057-00	Hex Hd. Screw (Taptite) 12-24x¾	4	.15
50463-00	Mounting Kit	1	6.00
	(2) 50115-00 Mast Clamp		
	(4) 50382-00 "U" Type Bolt (Stn. Stl.)		
	(4) 50502-00 Spacer		
	(6) Screw, Hex Hd. ¼-20 x1¼		
	(10) Hex Nut ¼-20 (Stn. Stl.)		
	(14) Lockwasher, Split ¼"		

To order parts, remit check or money order for total parts cost plus $1.00 for postage and handling to: Cornell-Dubilier Electronics, Department "C", 118 E. Jones Street, Fuquay - Varina, N. C. 27526

Prices subject to change without notice. CDE reserves the right to change prices at its option. Current prices may be obtained by calling or writing the factory. Please send self addressed stamped envelope.

HAM II SPECIFICATIONS

- Input Voltage: 115 VAC 50-60 HZ
  Optional: 220 VAC 50-60 HZ
- Motor: 24 VAC, 2.25 Amp, Split Phase
- Power transformer: 115/26 VAC, 10% duty, thermal protected.
  Optional: 220/26 VAC
- Meter transformer: 115/23 VAC, continuous duty.
  Optional: 220/23 VAC.
- Meter: D.C. voltmeter 1000 ohms/volt
- Meter scale: Direct reading, North centered. 5° increments.
  Optional: South Centered.
- Recommended cable: Belden 8448 or equivalent for up to 45 meters (150 feet).
  Two wires No. 18, 6 wires No. 22.
- Maximum Cable Resistance: Not over 1 ohm for conductors 1 and 2. Not over 2.5 ohms for conductors 3 through 8.
- Rotation time: 45-60 seconds with 60 HZ input.
- Brake: Positive, electrically operated wedge. 96 segments spaced 3° 45' apart.
- Rotator size: 20 cm (8") maximum diameter by 50 cm (20") high with lower mast support. Without lower mast support, 34 cm (13.5") high.
- Permissable mast size: From 35 mm (1.37") to 52 mm (2.062").
- Control box size: 20.5 cm (8.125) wide x 21 cm (8.25") deep x 10.5 cm (4.125") high.
- Mounting hardware: Stainless steel.
- Shipping cubature: 37,350 cucms (2280 cu. in.).
- Shipping weight: 13.15 kg (29 pounds).

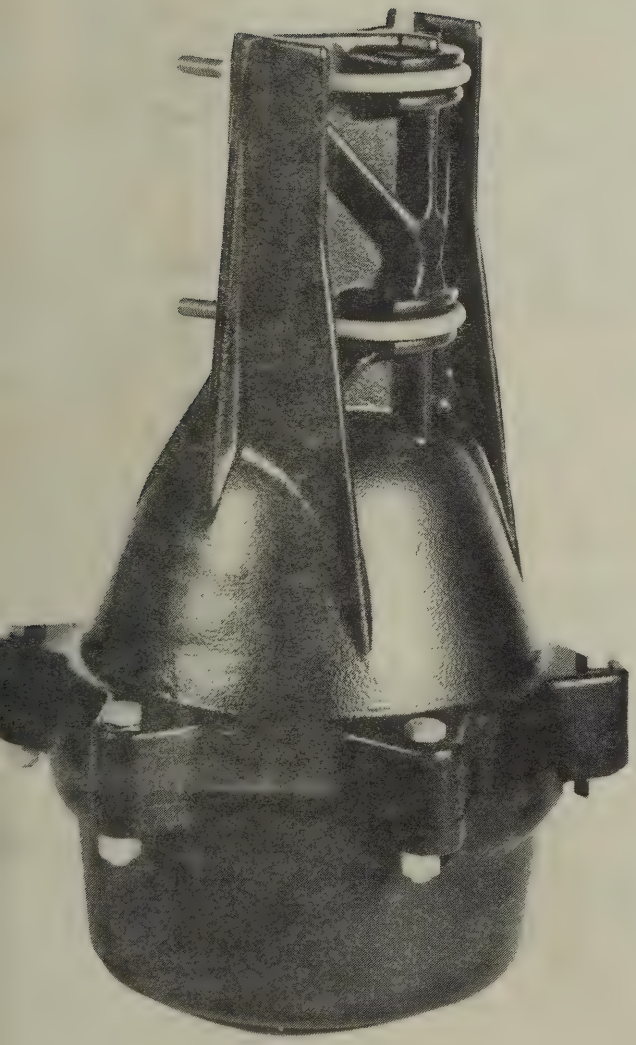


CDE HAM II ROTOR

CDE

TAILTWISTER™

MODEL T²X - ROTOR



Owner's Manual

CORNELL-DUBILIER ELECTRONICS
DIVISION OF FEDERAL PACIFIC ELECTRIC COMPANY
Rotor Department
Fuquay-Varina, North Carolina 27526

TAILTWISTER™

MODEL T²X

INSTALLATION AND OPERATION

I. CAUTIONS - READ CAREFULLY

A. Install **PROPERLY AND SAFELY.**

B. Towers, often the highest **METAL** parts in the vicinity, **REQUIRE EXTREME CAUTION** during erection and placement. **EXTREME CARE** must be taken during erection so that **METAL TOWERS AND BEAMS DO NOT CONTACT POWER LINES** even if the beams slip or rotate, towers fall or fracture, or metal wires blow in the wind, etc.

C. Metal towers or other position mechanisms **MUST BE PLACED SO THAT IF THEY FRACTURE OR BLOW OVER** in high winds, **THEY CANNOT CONTACT POWER LINES**, be a hazard to individuals, or endanger property.

D. When not mounted within a tower with a thrust bearing as shown in Figure 1, the rotator must be **DERATED** - See specifications.

E. Metal towers must be **GROUNDED PROPERLY** at the **TOWER LOCATION BEFORE THE TOWER IS ERECTED.** This is to minimize electrical hazard and the possibility of lightning damage. Do not bury bare aluminum wires or stakes in the ground. Use copper ground stakes. The service entrance ground should be checked. The household 120 VAC convenience outlet should be the 3-prong type (grounded back to the service entrance).

F. The **CONTROL BOX** is not weather-proof and must be located in the house, ham shack or other **PROTECTED LOCATION.**

G. Read this manual fully **BEFORE PROCEEDING.**

The Tailtwister rotor has been carefully designed and manufactured to give many years of trouble-free service when carefully and professionally installed. It consists of the strongest and best commercially available components. The design is based upon many years of experience by the Bell Rotor People - Cornell-Dubilier Electronics in North Carolina.

II. COMPONENTS OF THE TAILTWISTER

The Tailtwister rotor consist of an extra heavy duty rotator and control unit . The rotator is designed to be mounted on a plate inside a tower. A mast to support and turn large communications beams (see figure 1) is then attached to the top of the rotator. The rotator must be wired to the control unit with eight-wire cable. The control unit may be placed inside the house or other protected location. Included with the rotor are:

A. Owners Manual P/N 51421-10

B. Rotator P/N 51486-10

C. Mounting hardware kit P/N 51422-10

D. Control Box P/N 51479-10

Each installation has different requirements. There are a wide

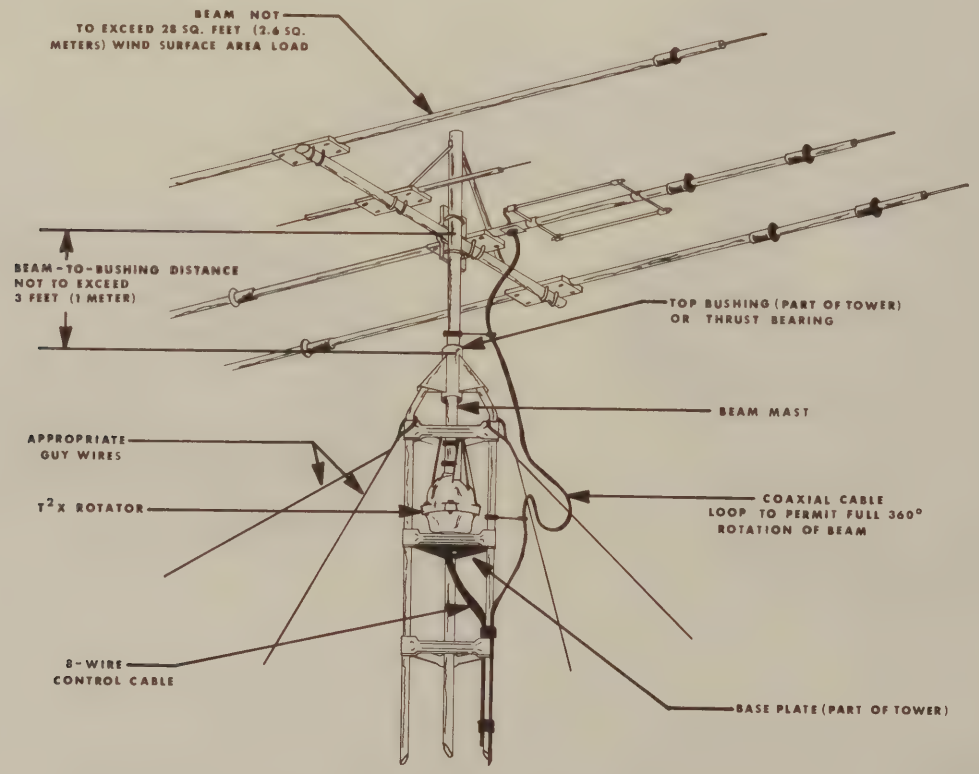


FIG. 1 - INSIDE TOWER MOUNTING

variety of towers available. The wire gauge of the 8-wire cable to connect the control unit to the rotator **DEPENDS UPON THE DISTANCE BETWEEN THE ROTATOR AND CONTROL.** The longer the distance the larger the diameter of the wire required. Various antennas or beams require different installation methods. For this reason, the owner must procure the remainder of the components after checking their compatibility. In general, these will be:

A. The beam or antenna desired and a suitable antenna mast.

B. A tower or other mechanism to position the rotator and beam for safe and effective rotation (see **CAUTIONS**).

C. 8-wire cable to connect the control to the rotator. (See specifications).

D. Coaxial cable to connect the beam to the communications equipment.

E. Appropriate guy wires as required.

F. Grounding hardware.

G. Optional lower heavy duty Mast Support Kit must be procured if the owner elects to use an "outside" tower mount (see figures 2 and 3). The part number for the Lower Mast Support Kit is 51467-10. "Inside" tower (figure 1) is recommended.

III. INSTALLATION INFORMATION

A. TYPES OF INSTALLATIONS

There are three general types of installations (see figures 1 through 3).

1. **THE RECOMMENDED INSTALLATION** is an "inside" tower mount with a top bushing or bearing to provide support and resist high wind loads.

   When the rotator is properly mounted this way, it can be rated to turn an antenna or beam of 28 square feet (2.6M²) wind surface area. The wind loading during storms, the rotational intertia of the beam, and unbalanced weight are more important than the dead weight of the beam. It is important to minimize the height of the beam above the rotator to minimize the overturning force induced in a high wind (see "Unbalanced Weight" and "Wind Pressure").

2. An "outside" tower mount as shown (See Figure 2) is optional. The rotator is not as well protected but the installation is simpler. The owner must procure the Heavy Duty Lower Mast Support Kit, P/N 51467-10, to install as in figure 2 and derate to 12.5 square feet (1.16M²).

3. A telescoping or other type as shown, see figure 3, can also be used. This installation is similar to #2 above and requires the optional Heavy Duty Lower Mast Support Kit and must be derated to 12.5 square feet (1.16M²)

There are variations of the above falling generally into one of the above categories. For example, the rotator may be mounted lower in the tower than shown in Figure 1. In that case, more than one bushing or thrust bearing for the beam mast may be required and longer coast down time allowed in operation. These factors are interrelated and the components must be matched together.

B. UNBALANCED WEIGHT AND WIND PRESSURE

1. **UNBALANCED WEIGHT:** Weight should be as closely balanced as possible. Unbalanced weight creates a bending moment of force which is concentrated on the mast at the

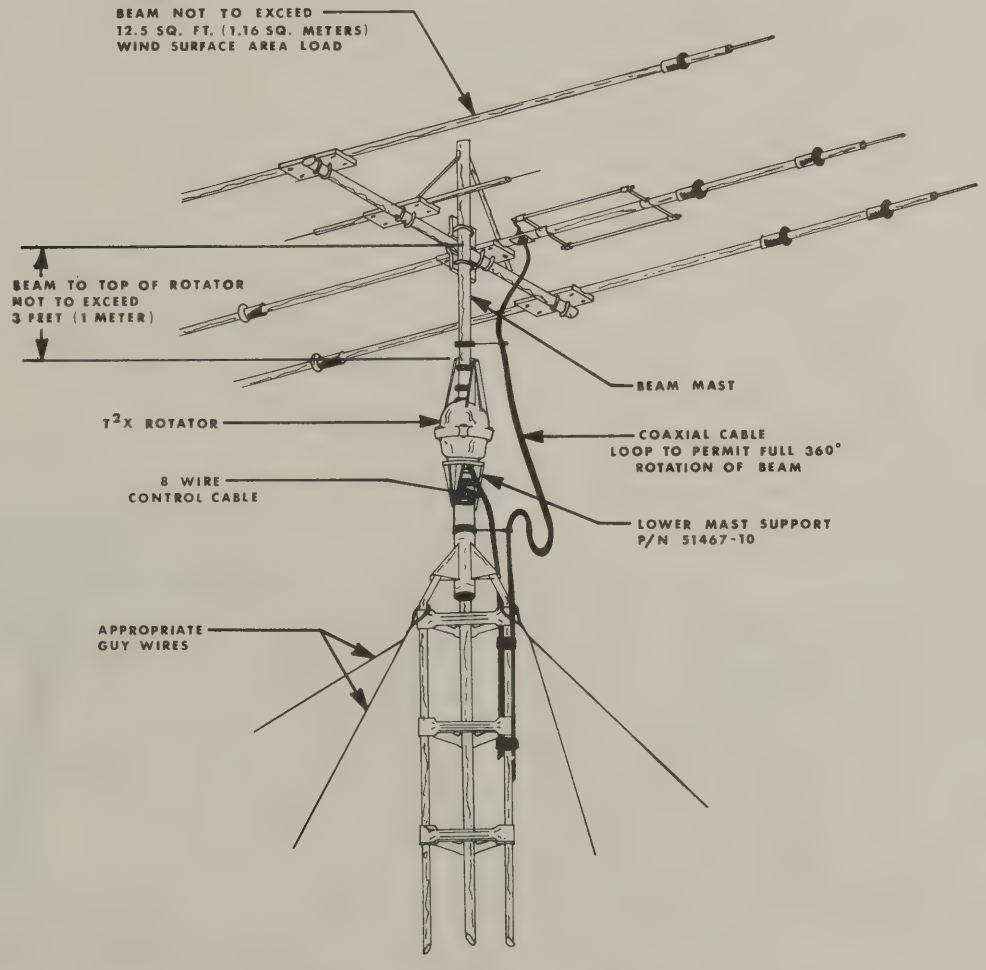


FIG. 2 - TOP OF TOWER MOUNTING

point where it is clamped to the top of the rotor.

This moment tends to strain the mast at that point and also to bind the ball bearings by creating excessive downward pressure on one side and upward pressure on the other. Such unbalance places additional stresses on the motor and gear train. Unbalanced weight becomes critical as the distance from the antenna boom to the clamping point at the rotor is increased.

2. **WIND PRESSURE** against the boom and elements produces a bending force on the mast which can cause the same stresses as unbalanced weight. To strenghten the installation to withstand unbalanced weight and wind pressure, the top mast should be as short and as strong as possible. In multiple arrays the heaviest sections should be closest to the rotator. In order to distribute the bending stress and prevent fracture of the mast, the T²X rotor includes a specially designed steel clamping plate to clamp the mast to the rotator.

After procurring the type of tower or other positioning mechanism of the owner's choice, the next step is to wire the rotator to the control box and check out its operation prior to installation.

IV. WIRING AND CHECK-OUT

A preliminary operational check should be made prior to installation. We recommend the following procedure:

A. Decide the wire gauge (size) required and procure the number of feet of the proper cable - see table, on page 11.

B. Strip and tin 3/8" on both ends (16 wires) after removing about 4 inches of the jacket. Tinning can be accomplished, after twisting the strands together, with an ordinary soldering iron and radio solder being careful not to melt the insulation.

C. With the control unit and the rotator on the work table, connect the cable between the rotator and control unit using the full length of cable that will be used in the installation. **IT IS IMPORTANT THAT #1 TERMINAL ON THE ROTATOR IS CONNECTED TO THE #1 TERMINAL ON THE CONTROL UNIT AND SO ON. NOTE:** That the specifications call for **HEAVIER** guage wire in two locations. **LEADS** #1 and #2 must be **HEAVIER GUAGE** and less total lead resistance (See specifications Page 11). Wire the control to the rotator as shown in figures 4 and 5.

CAUTION - - SHORTS BETWEEN TERMINALS OR GROUNDED LEADS MAY DAMAGE THE ROTOR.

D. With the rotator sitting in the upright position and connected to the control unit, by the eight (8) wire cable, plug the control unit power cord into a 120 VAC 50/60 Hz wall socket.

E. Turn the power switch on. The meter should be illuminated.

F. Depress the "Brake Release" (center) lever, then release it. An audible click should be heard in the rotator. This is the solenoid operating the brake wedge. The green lamp should go on to show when the brake is retracted.

G. Depress the brake release switch, hold, and then depress the counterclockwise direction switch (left). The rotator will turn counterclockwise (looking from top). Release the direction switch; the rotator will coast down and stop. Now release the brake switch. The rotor is locked in position. The red lamps should indicate direction of rotation. Note that the red lamp will not operate unless the green lamp is lighted showing that the rotator will not rotate without the brake having been retracted. Return rotator to full clockwise position.

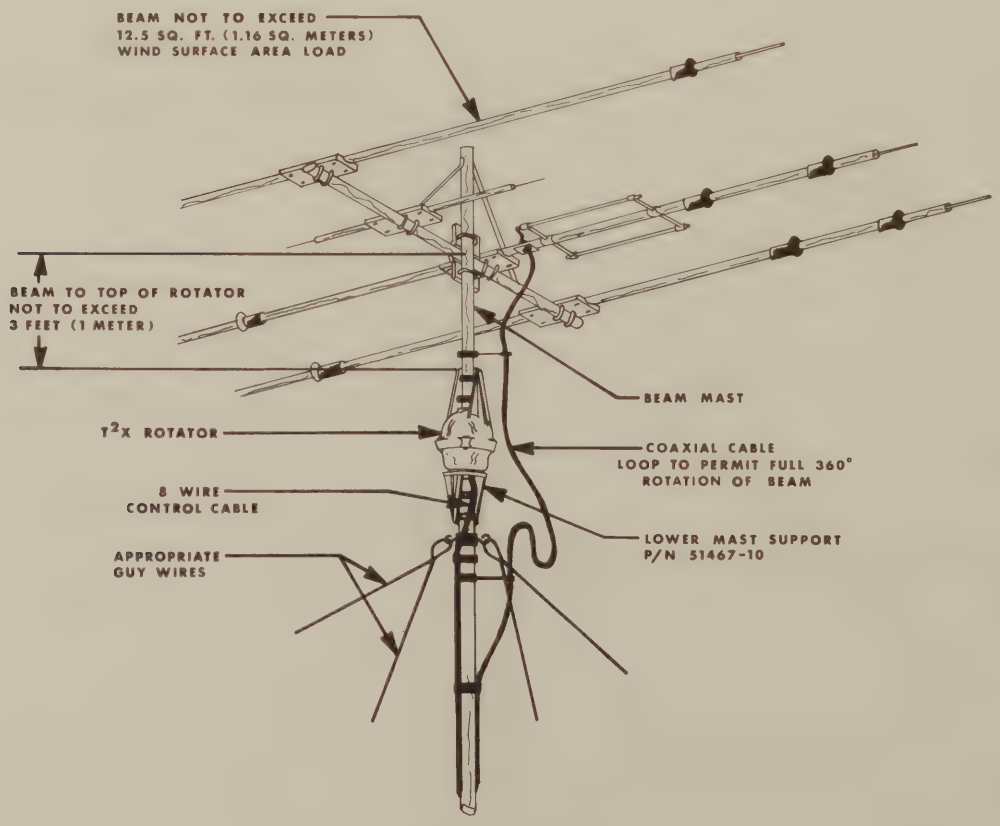


FIG. 3 - POLE MOUNTING

V. MOUNTING THE ROTATOR

A. **INSIDE TOWER** The rotator is mounted inside a tower (see figure 1) to the flat tower plate by means of six bolts furnished in the hardware kit. Use the following procedure:

1. Locate the rotator in the tower directly under the bushing. Note that the tower plate must be cut out to allow the connecting 8 wire cable to pass through the plate.

2 Re-attach the wires to the rotator in **EXACTLY** the same manner as used in the trial assembly and secure the wires to the tower in such a manner that the wires will not be strained.

3. The rotator is attached to the tower plate by means of 6 bolts and lockwashers (see figure 6). The flat tower plate must be drilled in six places using the template provided with this manual unless the tower plate is already properly drilled.

4. Tighten the six bolts but not to final tightness. Observe how the rotator turns. It must rotate in such a manner as to turn the mast concentrically to the top bushing.

5. Trial assemble the mast to the top of the rotator using the U-bolts, nuts, and lock washers through the rotator and clamp plate as shown in Figure 6. The maximum mast diameter that may be used is 2" O. D. We recommend 1½" nominal **STEEL PIPE** with 1.9" O.D. in standard wall thickness of .145". For stacked arrays or very large beams, we recommend extra heavy duty wall thickness .200". Both steel pipes can be purchased to specification ASTM-120.

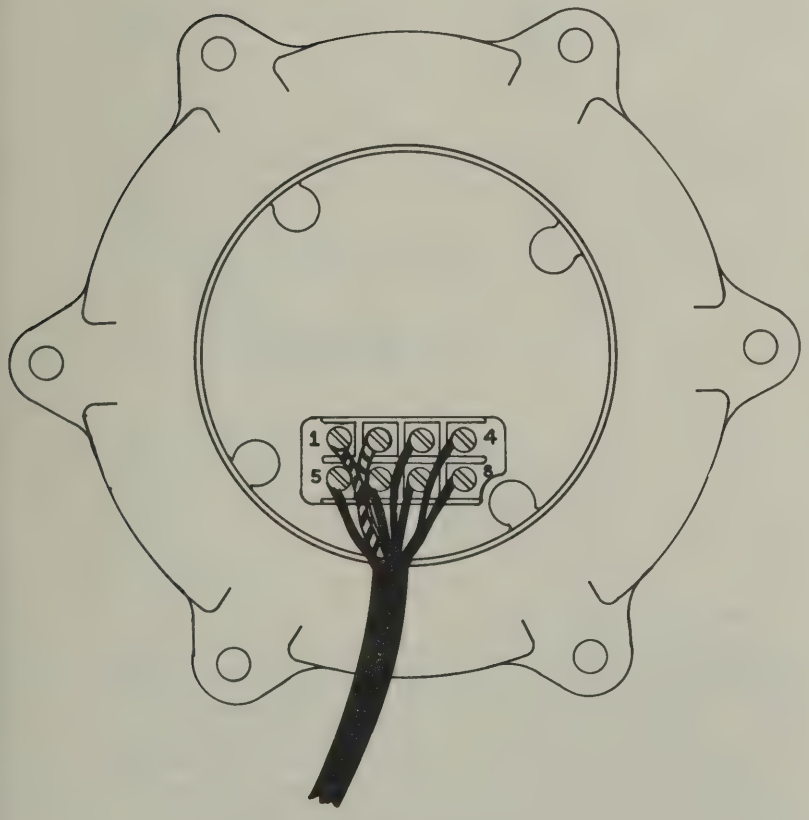


FIG. 4: ROTATOR WIRING

6. If the tower selected has a top bushing that provides adquate clearance as the rotor is turned through 360°, observe that it will turn without restriction, the final installation of the rotator may be completed. If not, the rotator may have to be moved slightly on the flat plate and/or the mast may have to be shimmed using 18 gauge (.050") steel shims between the mast and the V-shaped bell rotator casting.
If a high quality bearing is used in the top of the tower (RECOMMENDED) the shimming procedure must be done more carefully as closer tolerances are required. **IT IS IMPORTANT THAT THE ROTATOR NOT TRY TO TURN THE MAST ECCENTRICALLY WITH THE TOP BUSHING OR BEARING.**

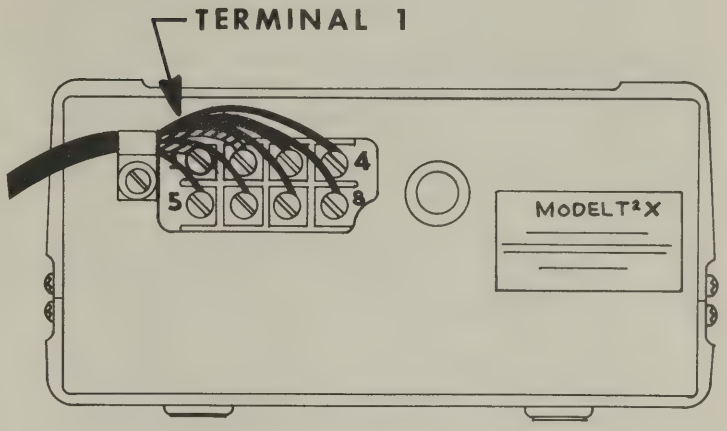


FIG 5: CONTROL UNIT WIRING

7. Tighten the six bolts carefully - to approximately 175 inch pounds of torque.

8. Drill through the antenna mast, and rotator casting using a 5/16" drill, locating on the hole in the clamp plate that is furnished. Insert the bolt through the clamp plate, mast and rotator and tighten this bolt assembly to 150 inch pounds. Refer to figure 6.

9. Return the rotator to the full CW "S" position. Mount the beam pointing South. The coaxial cable should be looped as per Figure 1 in such a manner that it will not foul or tangle when the beam turns around in a circle to the full 360° clockwise position.

B. **OUTSIDE TOWER**
Referring to figures 2, 3 and 7 an outside tower or pole mount is made in the same manner except that the rotator is fastened by four bolts only (not six), to the lower mast support, P/N 51467-10. Since the eccentricity of the rotator turning in reference to the tower is no longer important, the shimming procedure is not necessary. The four screws must be torqued to the same specification and the 8-wire cable securely fastened. The lower mast support should be pinned with the bolt provided by drilling in the same manner as described for the upper bell casting. **CAUTION:** The rotator is designed for vertical operation with the bell shaped housing in the up position Water and other contamination will get into the motor unit if it is mounted horizontally or up-side down.

VI. OPERATION

A. PRELIMINARY CHECK AND CALIBRATION

1. Turn the control box "on" with the upper right "on-off" switch. The meter should be lighted and the needle should be to the right.

2. Depress the brake lever (Center) and hold. Depress the CCW lever (left) and operate the rotator to its full CCW position. If the meter does not move from the right to the left hand position, press and release the "calibrate" switch.

3. With the rotator in its full CCW position, if the meter is not at its full position, carefully adjust the zero (CCW South) position with the screw directly under the meter to exactly South.

4. **METER CALIBRATION** of the extreme full scale (right hand or clockwise South) can be accomplished at any time without disturbing the rotator using the following procedure:

   a. With the control unit "on", push in and release the "calibrate" knob.

   b. The meter should now indicate full scale to the right. If it does not, turn the calibrate knob until it does.

   c. Without turning the knob, push it in and release it. The right scale is now fully calibrated to adjust for minor variations in component values. Do not, then, turn the knob, even in the "push-off" position because to do so will require that it again be re-calibrated.

5. Return rotator to its full CW end of rotation.

When the control unit is turned "off", the meter needle will fall to the left "S" position and return to indicate the rotor position as soon as the control unit is turned "on" again. It will not damage the unit to leave it turned "on" for extended periods.

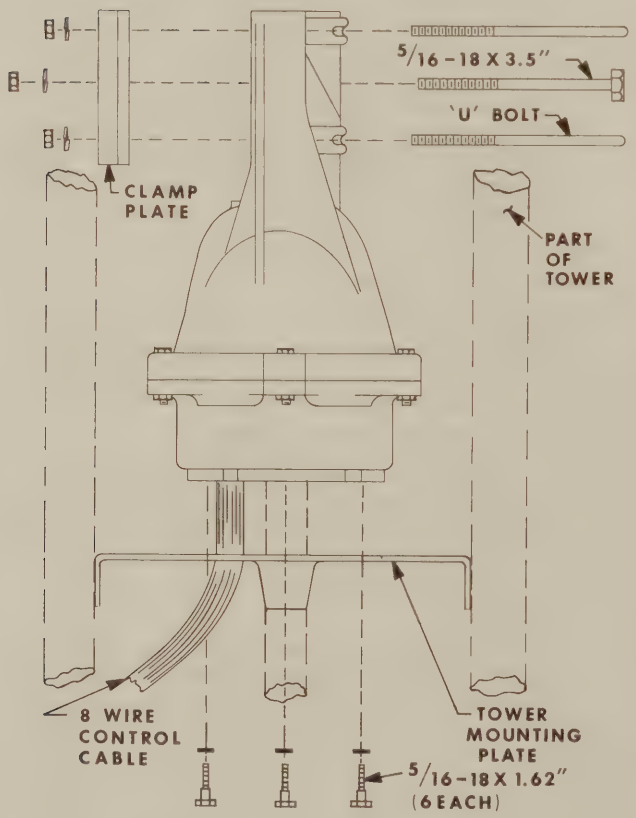


FIG. 6
ROTATOR MOUNTING
IN A TOWER

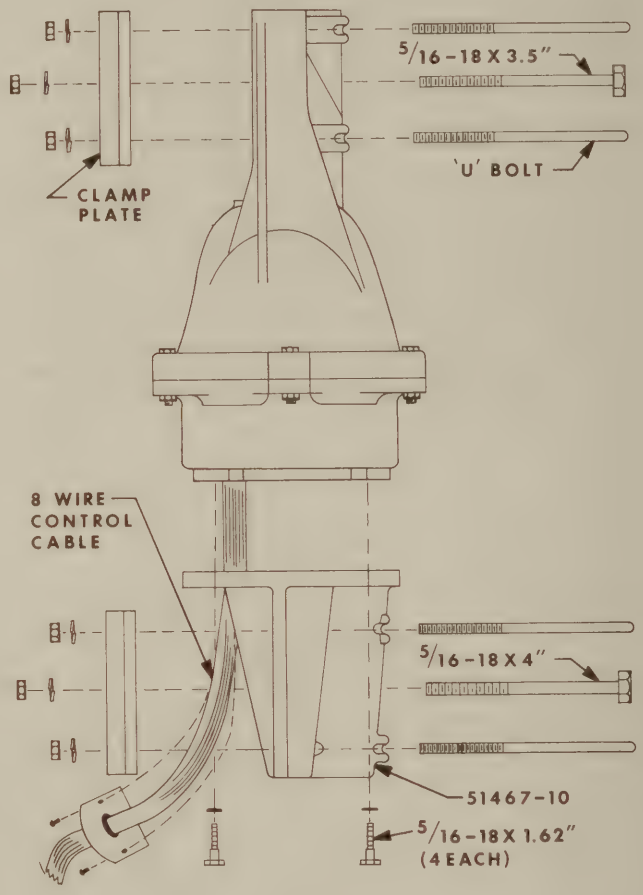


FIG. 7
ROTATOR MOUNTING WITH
LOWER MAST SUPPORT

B. NORMAL OPERATION

To operate the rotor, it is necessary to understand the **T²X BRAKE RELEASE LEVER** and its function. The brake lever (middle lever) on the **CONTROL UNIT** operates a brake wedge mechanism in the rotator which locks the rotator into position mechanically. The rotator cannot turn unless the wedge is retracted by depressing the middle lever (green light on, indicating that the operator can then turn the rotator). The normal operation is as follows.

1. Retract the brake wedge by holding down the "Brake Release", middle, lever (green light on).

2. Turn the rotator to the desired compass location by pushing down and releasing either the left hand lever or the right hand lever. **ALLOW A FEW SECONDS FOR THE ROTOR TO COAST DOWN.** Then re-engage the brake wedge by releasing the "Brake Release" (middle) lever.

C. OPERATING PRACTICE

The rotator has several mechanisms to protect it from misuse but the following **PRECAUTIONS ARE ADVISABLE:**

1. If you have a very large beam, the rotor can be "nudged" to exactly the desired position by alternately working the left and right control, allowing it to **COAST DOWN** before the brake wedge is allowed to engage.
2. It is advisable not to run it full speed into the end of rotation.
3. Upon completion of turning, always allow the rotor to coast down by keeping your finger on the "Brake Release" after you have released the rotation lever. This procedure will allow the rotator to stop **before** you re-engage the brake wedge. Observing this sequence prevents the rotator from stopping suddenly thus preventing undue stress on the rotator, beam, and tower.

The motor has an internal brake which controls the coast down time and deceleration. The internal motor brake is usually strong enough to prevent pinwheeling during operation even in high winds. If the rotator is being operated in a very high wind, observe the operation of the needle. A little practice will acquaint the owner how to operate the rotor smoothly.

VII. GROUNDING

The tower, or other metal support device must be grounded to earth ground **at location.** Use heavy copper cable looped so that if the tower comes down for any reason there will be adequate slack to prevent the ground wire from breaking. Use one or more 18" copper jacketed steel stakes driven into the moist earth and fasten the wire securely at the stake and at the tower.

As mentioned in the "Cautions" portion, the steel chassis of the control box should be either grounded to a cold water pipe in the house or back to the electrical service entrance box where the power comes into the house. This normally is accomplished with the third wire of the 3 prong plug which then depends on the 120 volt wall outlet being adequately grounded back to the service entrance as well as to the utility ground. If there is any doubt, have this checked by a licensed electrician.

VIII. SOUTH CENTERED METER SCALE CONVERSION

The stock Tailtwister T²X control unit shipped with the meter scale installed for North center operation, ends of rotation at the South position. Since some geographic locations and/or popular working areas may favor having the Meter South Center, ends of rotation at the North position, we have provided the T²X with a reversible meter scale.

WE RECOMMEND THE FOLLOWING PROCEDURE:

1. Disconnect the 120 VAC power cord.
2. Remove the eight - wire control cable, carefully labeling each wire with its corresponding terminal number, This operation may be omitted if the control box can be worked on easily without removing the leads.
3. Remove the top and bottom covers.
4. Slip the lamp and holder off the lamp holder bracket. Loosen the hex nut on the transformer that is holding the lamp holder braket and swing the bracket clear of the wires leading to the printed circuit board.
5. Carefully remove the hex nuts on the meter studs to free the printed circuit board. Slip the P. C. board off the studs and pull it down under the chassis. **Caution:** It is good practice to use a short test lead or jumper wire to short the meter movement when it is not in the circuit.
6. Loosen the meter retaining clips and remove the meter from the chassis.
7. Insert a small pin knife between the clear meter cover and black housing at either corner of the top edge and gently pry the cover loose from that corner. Repeat for the other corner. Meter cover should pop off.
8. Carefully slip a pen knife under each corner of the lower edge of the white meter scale and twist slightly until the scale clears the two small indexing pins. Remove the scale, turn it over, and re-install it. Make sure the scale fits over the indexing pins and that it is flush and tight against the black housing. This will assure free movement of the indicator needle.
9. Re-install the meter (remove the temporary jumper), the P. C. board, and lamp hardware. Check for pinched, shorted and/or overstressed wires.
10. Re-install the top and bottom covers.
11. Re-connect the eight wire control cable in the exact sequence as they were removed.

If your beam was installed originally using the T²X with a North Center Scale, the antenna mast must be loosened and repositioned. In order for the meter to indicate properly, the front of your beam must point North when the rotator is at the ends of rotation.

Re - calibrate the meter.

IX. OPTIONAL ACCESSORY KITS

51467-10 HEAVY DUTY LOWER MAST SUPPORT KIT $29.95

The stock Tailtwister T²X is intended to mount on the base plate inside of the tower. However, in some instances outside tower or mast mounting is desired as per figures 2 and 3. This kit, part number 51467-10, contains a heavy duty lower mast support and the necessary hardware to facilitate mounting theT²X on top of a tower stub or mast. Caution, when the rotator is installed using the lower mast support kit, the antenna size must be restricted to 12.5 square feet (1.16m²) of wind surface area.

51491-10 MOUNTING HARDWARE KIT FOR LOWER MAST SUPPORT KIT $5.00

This hardware kit is offered for replacement of the hardware only of the lower mast support kit 51467-10. Parts included are:

Mast Clamp Plate (1)
"U" Bolts SS (2)
5/16 - 18 x 1.62" SS Hex Hd. Bolt (4)
5/16 - 18 x 4.0" SS Hex Hd. Bolt (1)
5/16 - 18 SS Hex Nuts (5)
Lockwashers (11)
Cover, Terminal
Screws (2)
Grommet

I CONTROL UNIT - GENERAL DESCRIPTION

See Page 12 and 13

1. **POWER:** The on/off switch is a turn-to-operate type. The unit is protected by a 3 amp line fuse which is located in a fuse holder on the back panel. The power transformer supplies power for the rotator motor and the wedge brake solenoid. The transformer is protected by a thermal cut-out switch located in the primary. If the cut-out switch opens, turn the unit off and wait 10 - 15 minutes before resuming operation.
2. **METER CIRCUIT:** The position indicator meter and its circuity is powered by the meter transformer. When the power switch is "on", the meter is illuminated and continually indicates rotator position. Stability is assured by the 13 volt zener regulated power supply. Circuit is protected by the ⅛ amp fuse
3. **CALIBRATION:** The calibration switch is a push-on/push-off, turn to adjust type. It calibrates the right hand position (full scale) of the meter.
4. **ROTATOR CONTROL:** CCW rotation is controlled by the left hand lever and CW rotation by the right hand lever. The center lever controls the wedge brake.

II ROTATOR - GENERAL DISCRIPTION

See Pages 14 and 15.

1. **OUTER HOUSING:** The upper mast support (bell) and the lower brake housing are cast aluminum. The two sections are joined by six (6) 5/16 - 18 stainless steel bolts.
2. **POSITION SENSOR:** The position sensing potentiometer is located in the top of the bell casting.
3. **DRIVE:** A low voltage AC motor and its associated gears drive the output ring gear at about 1 RPM. The ring gear inturn is mechanically interlocked to the upper mast support (bell)
4. **BRAKE:** The brake wedge and its associated components are enclosed by the lower brake housing casting. Sixty grooves are cast into the inside surface of the brake casting walls which are engaged by the brake wedge. The wedge is retracted by a solenoid which is controlled by the "Brake Release" (Center) switch on the Control Unit.
5. **ROTATION LIMITS:** Two electrical, end of rotation, limit switches, activated by the stop arm, disconnect the motor power just before the rotating bell housing reaches its full CCW or CW (360°) position.
6. **BEARING:** Three rows of ball bearings are provided. Lubricate sparingly with factory approved special low temperature grease (P/N 51497 - 10).

III TROUBLE SHOOTING

A. GENERAL

Most operational difficulties with rotors are traceable to broken, shorted, or grounded wires usually at the terminal strips. Time spent in cutting the leads to exact lengths, tinning, forming, and wrapping around terminals, cutting insulation to exact length, and clamping to prevent strain on any single wire, will pay dividends.

B. MECHANICAL PLAY

Frequently the slight motion of the antenna array in gusts of wind is due more to the natural flexing of the elements and mast than it is due to actual play in the rotor mechanism. A slight amount of "play" is built into the rotator to avoid binding due to enviornmental changes.

C. ANTENNA ROTATES IN HEAVY WIND

This is usually a matter of the mast slipping in the support. For large arrays it is often necessary to drill a 5/16" hole through the clamping plate, mast and mast supports and pin them together with the non-corrosive fastening supplied. If "slipping" or "turning" is suspected, return the rotator to the end of rotation and visually check to be sure that the antenna is in the original stop location as installed.

D. LACK OF POWER

If the antenna rotation is slow or sluggish or hard to start, check for proper voltages. If the voltages are correct, the 120 - 140 MFD motor start capacitor could be at fault. It is recommended that a new capacitor be tried before futher action is taken.
If the electrical circuit is OK, then check for mechanical binding. Pay particular attention to bearings and alignment of the shaft on an inside tower mount. On any inside tower installation, care must be exercised to get the top mast shimmed to the exact rotational center of the rotator upper mast support. The geometry is such that a mast of 2.0"O.D.(51mm) will be exactly centered.

E. IMPROPER METER INDICATION

The brake and motor operate independently of the indicating system. If the pilot light burns at proper brilliancy, the instrument transformer is OK and the output is not shorted. Check the ⅛AMP meter circuit fuse with an ohmmeter. Check for about 13 VDC across terminals No.3 and No. 7 with the switch operated. If the proper voltage is not obtained, check the individual components in the meter circuit. If the 13 VDC is present, check for 500 ohms across rotor leads No. 3 and No. 7. If 500 ohms is present from No. 3 and No. 7, see if the readings from No. 3 to ground and No. 7 to ground total 500 ohms.

NOTE: If the needle remains in the right hand "S" position check to be sure the calibration switch is not in the "calibrate" position.

An intermittent condition in any component in the rectifier or meter circuits within the control box, as well as in the cable or potentiometer circuit in the rotator itself can cause meter fluctuation or error. Possible causes of such trouble may be locallized by placing a test DC meter across terminals No.1 and No.7 or No.1 and No 3 comparing the action of the test meter with the panel meter.

F. NO ROTATION - INDICATION OK

Either the thermal cutout in the power transformer has opened or there is actually trouble in the motor circuit. After allowing time for the thermal cutout to restore service, proceed to "checking rotator from ground" and "checking control unit".

G. GROUND WIRES

Grounds on cable leads can burn out either the line fuse or the small fuse in the meter circuit. For full explanations, refer to the Schematic. If lead No.3 or lead No.7 is grounded, it shorts out part of the potentiometer so that as rotation progresses to the other end, the full DC voltage is applied across a decreasing portion until current becomes so high that the potentiometer burns out. Note also that any grounds may put an overload on the power transformer which could cause the line fuse to blow, or overload the rectifier circuit so that the ⅛ amp fuse blows.

H. CHECKING THE CONTROL UNIT

1. VOLTAGES WITH UNIT PLUGGED IN.

   To check the control unit, plug the line cord into 120 volt AC power. With no connections to the terminals turn the on-off switch to the "on" position, the meter light will illuminate. The meter needle will remain on the left hand "S". Terminals 1 and 2 should show 30 volts AC (approximately) when the brake lever is depressed.

   Terminals 1 and 5 should show 30 volts AC with brake release lever depressed and CW lever depressed.

   Terminals 1 and 6 should show 30 volts AC with brake release lever depressed and CCW lever depressed.

   Terminals 3 - 7 should show approximately 13 VDC.

2. RESISTANCES WITH UNIT NOT PLUGGED IN

   Disconnect the AC power source and remove the eight wire control cable. Be sure to tag each wire with the corresponding terminal number.

   The control box can be checked without removing the cover by using a volt-ohmeter to check values across terminals. Resistance across terminals No. 1-2 should read .4 Ohms. Read same value across terminals No. 1-5 with clockwise switch lever (right - hand) depressed and across terminals No. 1-6 with counter clockwise switch lever (left - hand) depressed. Resistance across input line cord with on - off switch in the "on" position and the brake lever depressed should read 3.8 Ohms.

I. CHECKING THE ROTATOR FROM THE GROUND

You may possibly avoid bringing the rotator down by making electrical checks from the control box position. This is done by disconnecting the 8 wires from the screw terminals and tagging them carefully No. 1 through No. 8 to correspond with the terminal numbers from which they were removed. From the schematic diagram it is apparent that the resistance of the lead wires will be added to the resistance of the motor windings and potentiometer strip in making the resistance checks as shown in Table 1. All readings taken at **OTHER** than end of rotation.

To Check	Read Resistance	Between Terminals
Brake Solenoid	.75 ohms + leads	1-2
½ Motor Winding	2.5 ohms + leads	1-8
½ Motor Winding	2.5 ohms + leads	1-4
½ Motor + Switch	2.5 ohms + leads	1-5
½ Motor + Switch	2.5 ohms + leads	1-6
Entire Motor	5 ohms + leads	8-4
Right Limit Switch	0 ohms + leads	8-5
Left Limit Switch	0 ohms + leads	4-6
Entire Pot	500 ohms	3-7
Pot Arm to + End	0 to 500 ohms	3-1
Pot Arm to — End	0 to 500 ohms	1-7

Table 1

IV. DISASSEMBLY OF THE ROTATOR

In order to service the rotator, the unit must be disassembled. We recommend the following procedure:

1. Set the rotator on a flat surface.
2. Remove the six 5/16-18 bolts and hex nuts and carefully raise the top casting to expose the potentiometer and drive mechanism.
3. Carefully remove the upper ball retaining ring. Keep it circular, and lay it on clean paper.
4. See that the potentiometer strip is clean and not burned at either end and that the arm is clean at the point of contact. Use only fine rouge cloth to polish the contact arm.
5. If the drive ring happens to be near the end of rotation, hold the unit horizonal, operate the top spur gear to rotate the mechanical stop on the drive ring away from the area of the limit switch. See that the mechanical stop lever (which is positioned between the two limit switches) will open each electrical contact before it hits the corresponding mechanical stop. Also see that the stop lever has not been deformed and that the electrical contacts are clean and uncorroded.

   Rotate the top spur gear several revolutions to determine that the motor and its bearings are operating freely. Look for broken teeth in any of the gears.
6. Lift the motor and brake mechanism out of the brake housing. Carefully remove the lower ball bearing retainer and place it on a clean piece of white paper.
7. Remove the ring gear from the motor base. This is accomplished by first pulling up on the side opposite the gear train. Then raise the entire ring slightly upward with the side away from the gear train so that it will slide out from under the gears. Examine closely for evidence of broken or worn teeth.
8. Examine the inside of the screw terminal strip to see that there is proper clearence between the solder lugs and frame and that there are no breaks in the insulation. Pay particular attention to the insulation at the point where the wires are held in the metal clip.
9. Examine the teeth in the brake casting.
10. To seperate the motor, pot, and gear assembly from the brake assembly, unsolder the soleniod leads from the terminals 1 and 2. Remove the screws holding the terminal board to the casting. Then remove the four large screws in the base. Be careful to clear the wires and the terminal strip through the opening.
11. Carefully remove the ball bearing retaining ring from the lower portion of the brake housing.
12. To remove the potentiometer, remove the hex nuts and unsolder the leads. The mounting studs are integral to the motor and bell. In replacing the pot be sure the connections are on the side which overhangs the motor.
13. To replace the motor, first remove the pot per Paragraph 12, then unsolder the black motor lead from the screw terminal 1, the red lead from the inside left limit switch lug, and the blue lead from inside the right limit switch lug. The fastenings holding the motor on the studs may then be removed and the motor pulled up and out. In replacing a motor, be sure to see that the round hole in the motor is next to the limit switch. Use a double lock nut on this stud near the limit switch, to provide clearance for the leads. Use special internal-external lockwasher over the stud that works in the slotted hole in the motor. Be sure that the pinion is snug against the spur gear before tightening this fastening over the slot.
14. When it is necessary to closely inspect or replace gears, it is possible to remove the motor, limit switch, pot, and terminal strip without unsoldering more than the solenoid leads from terminals 1 and 2. Remove the motor fastenings from the mounting studs. Work the motor up and out, exercising care in pulling the leads and terminal strip through the window in the gear housing. Remove the plate to expose the gears. Carefully note the positions for proper replacement.

V. RE - ASSEMBLY OF THE ROTATOR

It is assumed in the following instructions that the brake mechonism is assembled and operative. The motor and gear train along with the potentiometer and the limit switches are likewise

assembled and wired and operative.

It is not likely that the brake wedge will be exactly positioned in relation to the teeth in the brake housing to permit proper assembly unless the brake mechanism is retracted. For this reason it is necessary to operate the brake mechanism electrically during step 8 of the assembly of the rotator unit.

1. See that a small amount of low temperature, high quality, light weight grease is conservatively distributed around the ball bearings, ring gear, and spur gears. Only an even film of grease is desirable (approximately one thimbleful of grease should be used to lubricate a completely dry rotator). Excessive grease will only run out in high temperatures or cause power loss in low temperatures
2. Rotate the upper spur gear until the inwardly protruding mechanical stop on the ring gear engages the channel shaped stop lever and pushes it far enough to the right to just open the right hand limit switch contact (it is assumed that the rotator is viewed from the side of the limit switch). This situation represents the extreme counterclockwise end of rotation. The potentiometer arm must then be rotated to its extreme counterclockwise position against the top stop.
3. Secure the upper bell housing upside down by the mast support in a vise with the open end of the "V" toward the bench. The boss which drives the potentiometer arm which is located in the bottom part of the bell housing will then be to the left of center.
4. Clean the inner portion of the housing and apply a small amount of grease to the ball race. Then carefully insert one ball bearing assembly with the flanged rim up and against the outer edge of the casting.
5. Grasp the operating mechanism by the flat base, steady the ring gear, invert the mechanism and lower it into the housing. In doing this, note that the serrated portion of the potentiometer arm must engage the driving boss in the housing and that the three driving bosses on the ring gear must engage into the mating recesses in the top housing. This situation will result automatically if the previous instructions have been followed.
6. Clean the exposed bearing race and apply a film of grease. Then apply the top bearing assembly to the race with the rim downward.
7. Clean the brake housing and bearing race and apply a light film of grease. Place the ball bearing assembly in the lower portion of the brake housing with the retainer flange in the up position. Lower the brake housing into place so that the assembly holes will approximately line up with the threaded holes in the bell housing. **DO NOT MECHANICALLY FORCE AN EXACT ALIGNMENT OF THESE HOLES WITHOUT ELECTRICALLY RETRACTING THE BRAKE MECHANISM.**
8. Connect the control unit terminals No. 1 and No. 2 only to the corresponding terminals on the rotator while it remains clamped in the vise. Momentarily operate the "Brake Release". This will permit the brake housing to freely rotate for exact alignment of the holes. With the brake retracted, use the six 5/16-18 x 1.62" bolts, lock washers, and hex nuts to secure the upper mast support (bell) to the lower brake housing. Tighten finger tight. With the brake re-engaged, tighten all six bolts in an alternate pattern to approximately 175 inch pounds of torque. Recheck the brake to make sure that it operates freely.

It is suggested that all 8 wires be connected from the control box while the rotor is still on the bench and that its complete operation be checked.

VI. HOW TO GET FACTORY SERVICE

If service is required, the unit must be packed securely and sent prepaid to:

CORNELL - DUBILIER ELECTRONICS
Rotor Service Department
118 East Jones Street
Fuquay-Varina, N. C. 27526

For units that are in warranty, no charge will be made for any repair work required. Include a copy of your sales receipt. For out - of - warranty units, the following flat rate charges apply:

Control Unit Only	$35.00
Rotator Only	$60.00
Complete Unit - Rotator and Control	$75.00

The above flat rate charge includes rebuilding the unit, replacing all defective and/or worn parts, and return freight charges. CDE reserves the right to change prices at its option. When returning items for repair, a check or money order for the repair charges must be included. Be sure to include your name, address, zip code and telephone number. Also give a brief description of the problem.

LIMITED WARRANTY

CORNELL-DUBILIER ELECTRIC CORPORATION (CDE) warrants that your new ROTOR has been manufactured free of defects in design, material and workmanship. If this product fails to give satisfactory service due to defects covered by warranty, including any warranty implied by law such as WARRANTIES OF MERCHANTABILITY OR FITNESS, for a period of ONE YEAR FROM THE DATE OF PURCHASE, CDE will, at its option, replace or repair the unit, or any defective part free of charge.

To obtain warranty service, return the ROTOR to your dealer, or pack it securely, and send it with proof of purchase date and a letter explaining the problem, shipping cost prepaid, to: CORNELL-DUBILIER ELECTRIC CORPORATION, WARRANTY REPAIR DEPARTMENT, 118 E. JONES ST., FUQUAY-VARINA, N.C. 27526.

IMPORTANT

Warranty service covers repair or replacement of the ROTOR only. CDE is not responsible for costs of removal or reinstallation, or shipping to the place of repair. The warranty period is not extended due to repair or replacement.

CDE reserves the right to make reasonable charges for service if there is evidence of damage due to alteration, misuse or installation not according to the enclosed instructions.

CDE IS NOT RESPONSIBLE FOR DAMAGE TO OTHER EQUIPMENT OR PROPERTY OR FOR ANY OTHER CONSEQUENTIAL OR INCIDENTAL DAMAGES OF ANY KIND, WHETHER BASED ON CONTRACT, NEGLIGENCE OR STRICT LIABILITY. MAXIMUM LIABILITY SHALL NOT, IN ANY CASE, EXCEED THE PURCHASE PRICE OF THE UNIT.

(Some states do not allow limitations on how long an implied warranty lasts, or the exclusion or limitation of incidental or consequential damages, so the above limitations and exclusion may not apply to you.)

(This warranty gives you specific legal rights. You may also have other rights which may vary from state to state.)

IF YOUR UNIT IS DAMAGED, CONTACT YOUR DEALER OR THE SHIPPER. IF ANY OF THE ITEMS ARE MISSING, RETURN THE COMPLETE UNIT TO YOUR DEALER OR WRITE THE FACTORY FOR ASSISTANCE. A COPY OF YOUR SALES RECEIPT MUST ACCOMPANY ANY RETURN.

T²X SPECIFICATIONS

- Input Voltage: 120 VAC 50 - 60 Hz
  Optional: 220 VAC 50 - 60 Hz
- Motor: 24 VAC, 2.25 Amp, Capacitor Start, Capacitor Run
- Power Transformer: 120 VAC/26 VAC 10% duty, thermal switch
  Optional: 220 VAC/26 VAC 10% duty, thermal switch
- Meter Transformer: 120 VAC/23 VAC Continuous duty
  Optional: 220 VAC/23 VAC Continuous duty
- Meter: DC voltmeter 1000 ohms/volts, 1 MA full scale
- Meter Scale: Direct reading: North centered, 5° increments or
  South centered, 5° increments. (reversable scale)
- Recommended 8 - wire interconnect cable: Stranded Copper

Maximum Length	Gauge for Terminals 1 & 2	Gauge for Terminals 3 - 8
125' (38M)	#18 (1.19mm)	#22 (.76mm)
200' (61M)	#16 (1.42mm)	#20 (.97mm)
300' (91M)	#14 (1.75mm)	#18 (1.19mm)
500' (152M)	#12 (2.32mm)	#16 (1.42mm)
800' (244M)	#10 (2.95mm)	#14 (1.75mm)

- Maximum Antenna Size
  A. Tower Mounted as per Figure 1 - 28 square feet (2.6M²) of wind surface area.
  B. Outside Tower or Mast Mounted as per Figure 2 or 3 - 12.5 square feet (1.16M²) of wind surface area.
- Maximum Interconnect Cable Resistance:
  A. Terminals 1 and 2: .8 Ohm
  B. Terminals 3, 4, 5, 6, 7 & 8: 2.0 Ohms
- Rotation Time: 45 - 60 seconds with 60 Hz input
- Brake: Positive, electrically operated wedge. 60 segments spaced 6° apart.
- Rotator size: 9.32 inches (23.7 CM) maximum diameter by 14.07 inches (35.7 CM) high.
- Maximum antenna mast size: 2.0" O.D. (51 mm).
- Mounting hardware: Stainless steel hardware and plated steel clamp plate.
- Control unit size: 8.5 inches (21.6cm) wide by 9.0 inches (22.8cm) deep by 4.3 inches (11.0cm) high.
- Shipping volume: 1.32 cu. ft. (37,350 ccms).
- Shipping weight: 29 lbs. (13.15kg).

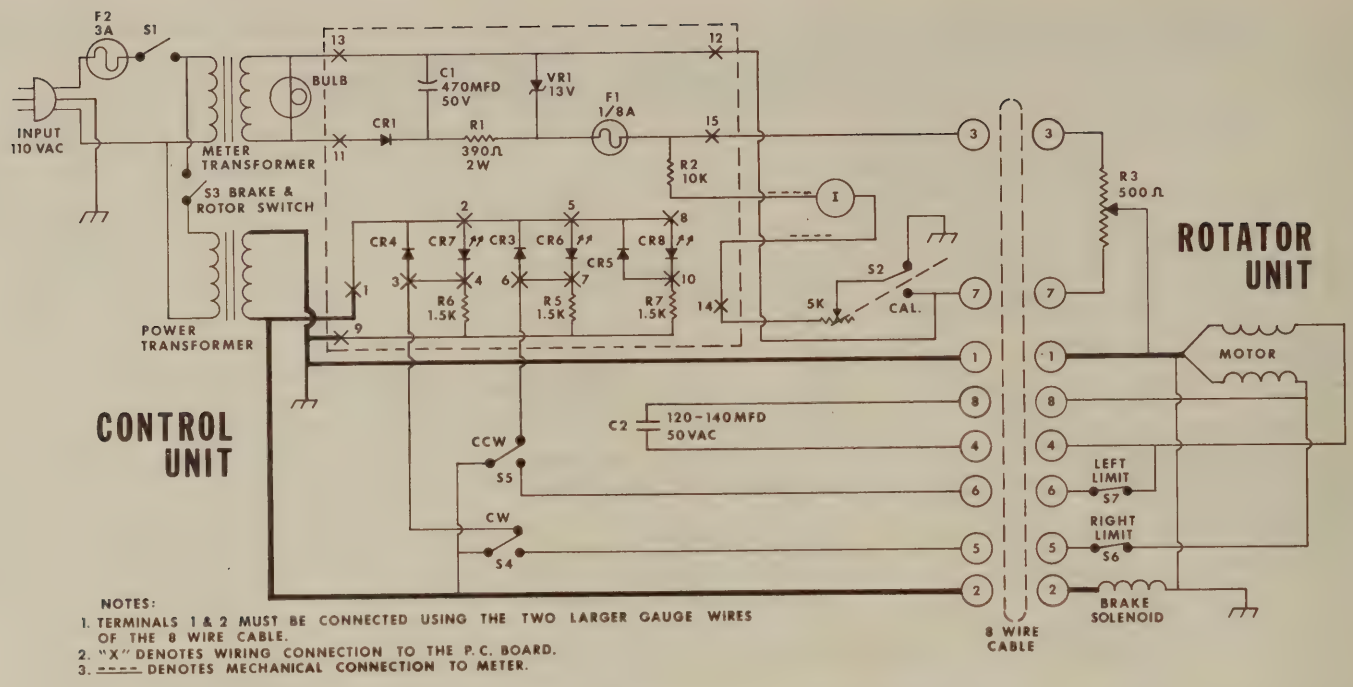


Fig. 8 T²X SCHEMATIC

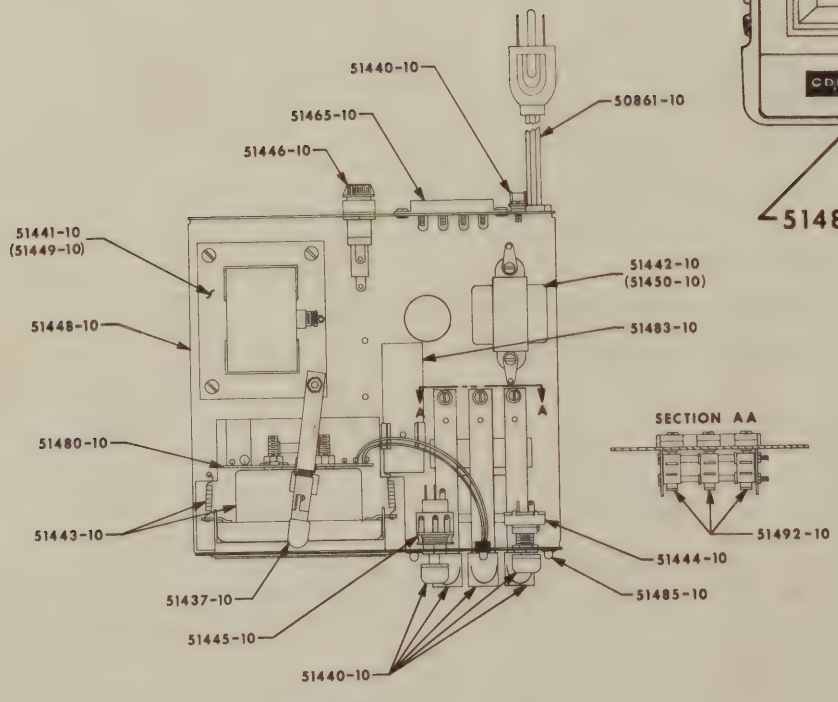


Fig. 9 CONTROL UNIT - TOP VIEW

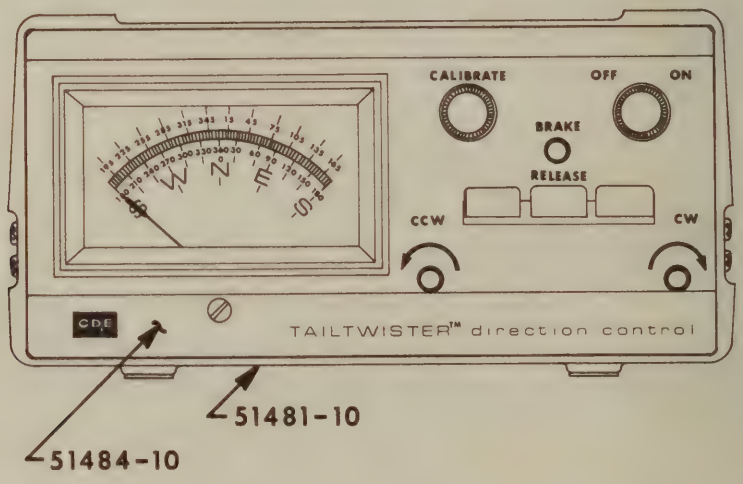


Fig. 10 CONTROL UNIT - FRONT VIEW

T²X CONTROL UNIT - REPLACEMENT PARTS KITS

Part Number	Description	Price
51479-10	Control Unit, 120 VAC Complete	$134.95
51480-10	Printed Circuit Bd. Assy. Kit	20.00
	Capacitor, 470 Mfd. 50V (1) C-1 Resistor, 390 Ohm 2W (1) R-1 Resistor, 10K Ohm 1/4W (1) R-2 Resistor, 1.5 Ohm 1/4W (3) R-5, R-6 & R-7 Diode, Zener, 13V 50 MA (1) VR-1 Diode, PIV 100V, 1A (4) CR-1, CR-3, CR-4 & CR-5 Fuse ⅛ Amp (1) F-1 Diode, Light Emitting, Red (2) CR-6 & CR-7 Diode, Light Emitting, Green (1) CR-8 Lead Wires (8)	
51437-10	Expendable Parts Kit	3.00
	Fuse, 3 Amp (2) F-2 Fuse, ⅛ Amp (2) F-1 Bulb, Meter (2)	
51492-10	Switch Kit	7.00
	Switch, (3) S-3, S-4 & S-5	
51485-10	Indicator Light Kit	2.00
	Diode, Light Emitting, Red (2) Diode, Light Emitting, Green (1)	
51481-10	Cover Kit	9.00
	Cover, Top (1) Cover, Bottom (1) Screws (8) Skid Pads (4)	
51482-10	Miscellaenous Hardware Kit	4.00
	Knob, On/off (1) Knob, Calibration (1) Terminal Board Assy. (8 terminals) and Screws (2) Lever, Switch (For S-3, S-4 & S-5) (3)	
51441-10	Transformer Kit (Power) 120VAC	18.00
51442-10	Transformer Kit (Meter) 120 VAC	11.00
51483-10	Capacitor Kit, Motor Start (1) C-2	6.00
50861-10	Line Cord Kit, 3 Wire	2.00
51499-10	Meter Kit	27.00
	Meter (1) Bulb Holder (1) Mounting Hardware Bezel (1)	
51444-10	Switch Kit, On/Off (S-1)	3 00
51445-10	Switch Kit, Calibration (S-2)	6.00
51446-10	Fuse Holder Kit (For F-2)	2.00
51484-10	Face Plate Kit	4.00
51448-10	Chassis Kit	10.00

To order parts, remit check or money order for total parts cost plus $1.00 for postage and handling to: CORNELL-DUBILIER ELECTRONICS, Department "C", 118 E. Jones Street, Fuquay-Varina, North Carolina 27526.

PRICE SCHEDULE AS OF APRIL 1980

CDE reserves the right to change prices at its option. Current prices may be obtained by calling or writing the factory. Please send self addressed stamped envelope.

T²X ROTATOR PARTS KITS IDENTIFICATION

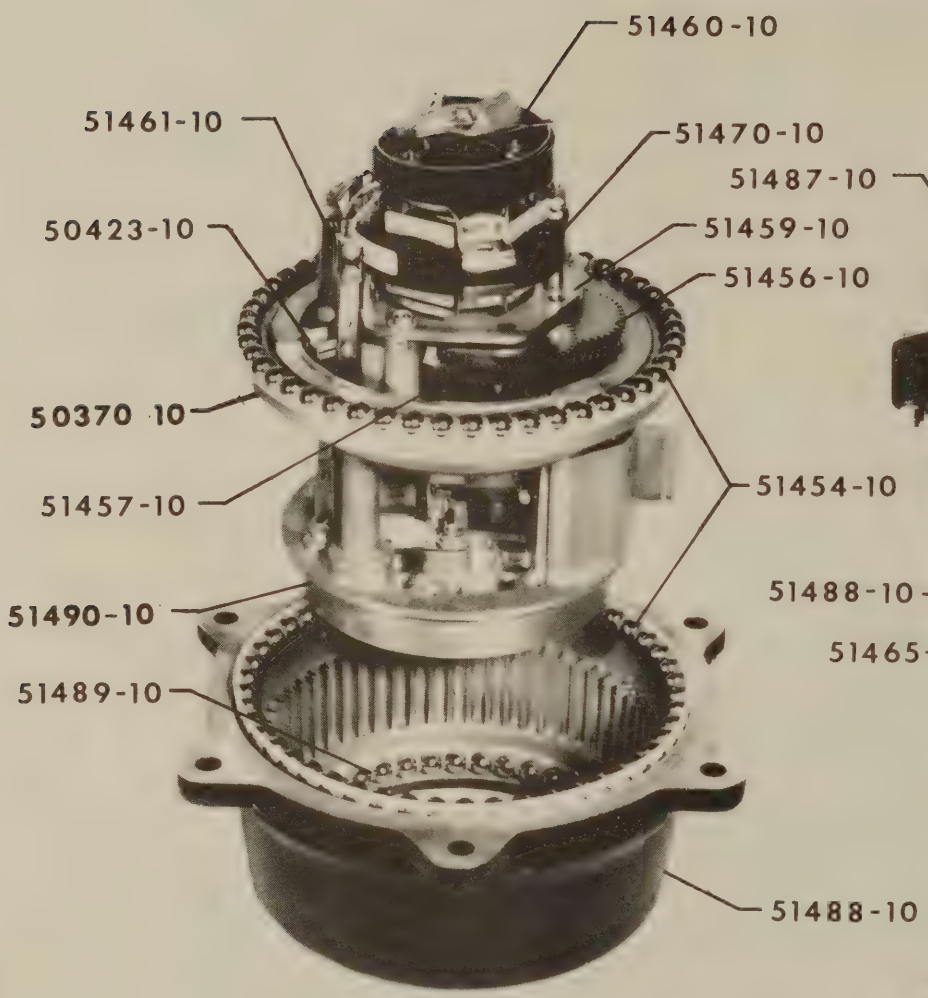


Fig. 13

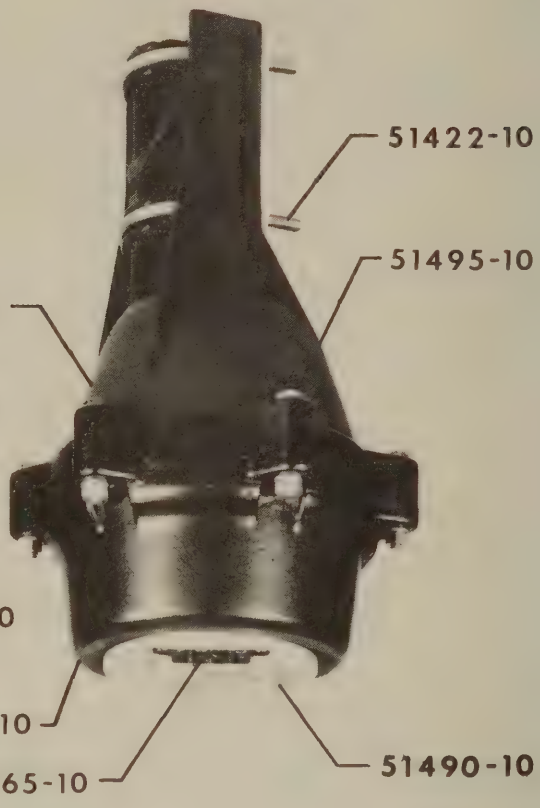


Fig. 11

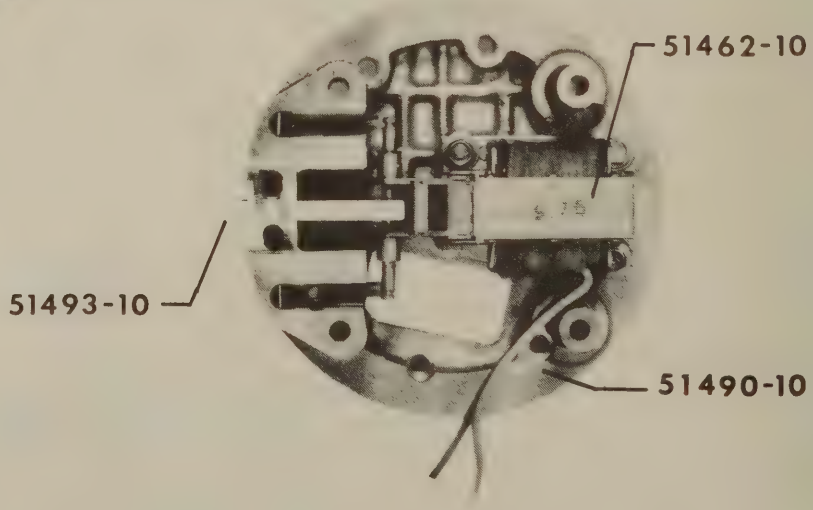


Fig. 12

T²X ROTATOR REPLACEMENT PARTS KITS

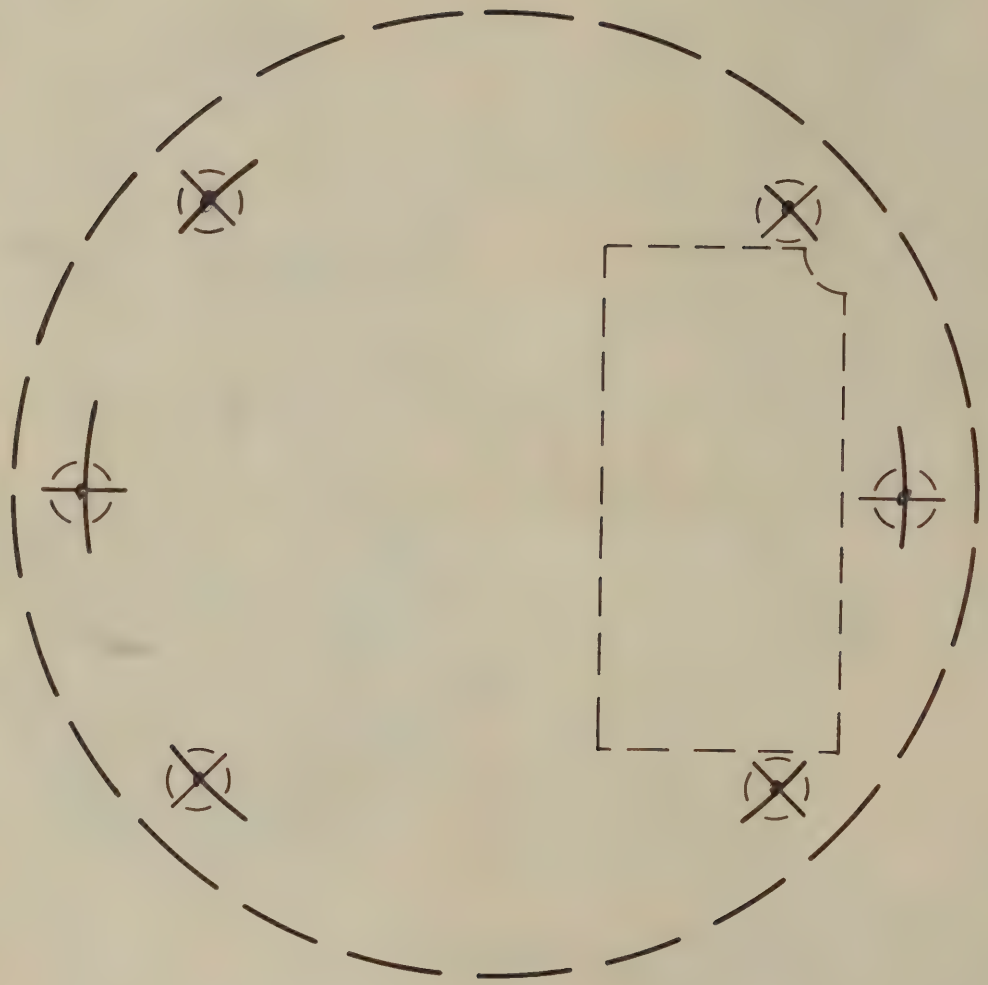
Part Number	Description	Price
51486-10	Rotator, Complete with Hardware	$199.95
51487-10	Upper Mast Support Kit (Bell Casting)	25.00
51488-10	Brake Housing Kit (Lower Casting)	20.00
51454-10	Ball Bearing Kit (2 required) Ball Bearings (49) Bearing Retainer (1)	8.00
51489-10	Ball Bearing Kit (1 Required) Ball Bearings (40) Bearing Retainer (1)	7.00
51490-10	Brake Support Casting Kit	12.00
51456-10	Gear and Pinion Kit Gear and Pinion (1st., 2nd. & 3rd. From Motor) (3) Gear and Pinion (Thick Pinion, 4th. From Motor) (1) Small Gear Spacer (1) Large Gear Spacer (1) Washer (3)	10.00
51457-10	Final Spur Gear Kit Final Spur Gear (2) Bushing For Gear (1)	9.50
51494-10	Ring Gear Kit	12.00
50423-10	Stop Arm Kit	2.00
50370-10	Base Casting and Gear Shaft Assy. Kit	6.00
51459-10	Motor Mounting Plate Kit	5.00
51470-10	Motor and Pinion (Brass) Kit	25.00
51461-10	End of Rotation Switch Assy. Kit Switches (2) Bracket (1)	4.00
51460-10	Potentiometer Kit (R-3)	11.00
51462-10	Solenoid (Brake) Kit	10.00
51493-10	Brake Wedge and Hardware Kit Solenoid Pin (1) Solenoid Pin Spacer (2) Solenoid Retaining Ring (2) Solenoid Retaining Spring (2) Retaining Spring Clips (2) Brake Wedge (1) Brake Wedge Support (1)	14.00
51465-10	Terminal Board Assy. (8 terminals) Kit Terminal Board (1) Screws (2)	2.00
51495-10	Hex Head Bolt Kit 5/16 - 18 x 2.0" S.S. Hex Hd. Bolts (6) 5/16 - 18 S.S. Hex Nuts (6) Lockwashers (6)	6.00
51422-10	Mounting Hardware Kit Mast Clamp-Plated Steel (1) "U" Bolts, S.S. (2) 5/16 - 18X 1.62" S.S. Hex Hd. Bolts (6) 5/16 - 18X 3.5" S.S. Hex Hd. Bolt (1) 5/16 - 18 S.S. Hex Nuts (5) Lockwashers (11)	12.00
51497-10	Grease, Special Kit (Quanity for one overhaul)	1.00

To order parts, remit check or money order for total parts cost plus $1.00 for postage and handling to: CORNELL-DURILIER ELECTRONICS, Department "C", 118 E. Jones Street, Fuquay-Varina, North Carolina 27526.

PRICE SCHEDULE AS OF APRIL 1980

CDE reserves the right to change prices at its option. Current prices may be obtained by calling or writing the factory. Please send self addressed stamped envelope.

CLEARANCE HOLES TO BE 11/32
(.87 CM.)



TOWER DRILLING TEMPLATE

OWNER'S MANUAL

CORNELL-DUBILIER ELECTRONICS

MODEL AR-22R

AUTOMATIC ANTENNA ROTOR SYSTEM

GENERAL

Model AR-22R Antenna Rotor is designed to support and rotate the largest television antennas. The rotor will support stacked arrays and deep fringe area antennas. AR-22R is **not** intended for large Ham beams. Large Ham beams may present a sufficiently high wind resistance to rotate the antenna without being energized. This will have the effect of changing the AR-22R synchronization. For very windy areas or large beams, the CDE TR-44 or HAM-M rotors are recommended.

The AR-22R is rated to support a dead vertical weight of 150 pounds, has 500 inch pounds of motor stall torque and resists an overturning moment of approximately 4000 inch pounds without guying. The control box will control to within 6° accuracy. The rotor is lubricated for long life and is suitable to approximately —15°F. The clicking sound when rotating is normal.

INSTALLATION

Prior to mounting the rotator on the mast, it is well to check the operation of both rotator and control box wired for each of the 4 connections. CAUTION — BEFORE OPERATING UNIT READ LABEL ON BOTTOM OF CHASSIS. Model AR-22R operates from 115 VAC 60 cycle.

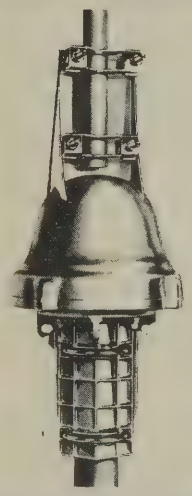
The rotator unit is shipped from the factory set at the end of rotation in full "NORTH" counter-clockwise position (looking down at top of rotor). The unit should be checked using all the wire to be used in the installation. The wire should be according to the recommended wire sizes.

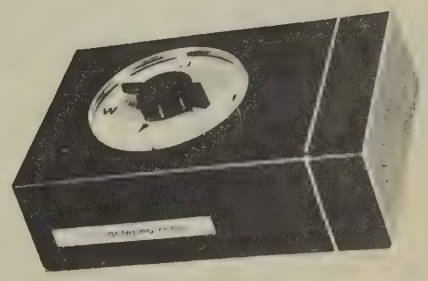
Note that the rotor mast clamps are reversible. Turning them allows clamping to large diameter (up to 2") or small diameter (down to 7/8") masts. The lower mast support may be removed from the rotor base plate so that the rotator without the lower mast support may be mounted in a tower.

Standard four-wire conductor cable is available at any electronics supply houses. Be sure to use the recommended sizes (gauges).

The lower mast support casting is shipped unmounted; feed the cable through the rubber grommet in the terminal cover plate and strip each conductor end. Connect as shown in Figure 1. Then mount the lower mast support casting to the Rotor base with four hex head bolts and lock-washers, tighten them securely.

To relieve strain on the antenna lead-in cable, standoff insulators should be mounted on the mast as follows: With the Rotor in "end" position, mount a standoff insulator directly above upper mast support and another immediately below lower mast support as shown. The standoffs should be 180° apart. Dress antenna down-lead through the standoffs, allowing sufficient slack for complete rotation. See Figure 2.





USE THE FOLLOWING WIRE SIZES:

Wire Gauge	Max. No. of Feet
22	100
20	150
18	220
16	350
14	550

GUYING

Two guy wire lugs are provided on the lower mast support casting for guying purposes. The use of standard 3/16" or 1/4" guy thimbles with adequate size wires, using turnbuckle adjustments, is recommended. Care should be taken not to tighten guy wires excessively. The installation should have a slight freedom of movement to prevent storm damage.

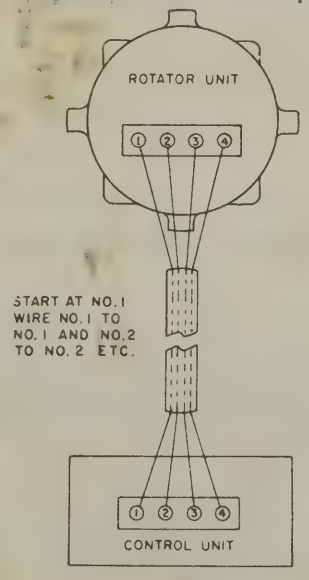


Fig. 1

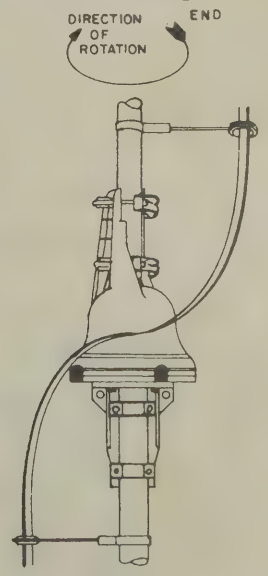


Fig. 2

The AR-22R control box is electrically identical to the previous model AR-22 and is fully interchangeable with previously manufactured AR-22 rotors.

CDE Rotor System AR-22R

SYCHRONIZATION

1. Synchronize the Rotor unit with the control box unit in 2 steps as follows:

1. Turn the knob to the extreme **counter-clockwise** position — do not force. If the lights remain on after pulsing stops, trip the synchronization lever found on the bottom of chassis until they go out.

2. Now turn the knob to the extreme **clockwise** position. If the lights remain on after pulsing stops trip the lever until they go out. The units are now synchronized.

ELECTRICAL AND LIGHTNING PROTECTION

Radio and television equipment installation practices are covered by the National Electrical Code. Two pamphlets are published, one concerning the electrical code, the other lightning protection. The former, Pamphlet NFPA 70-1971, Article 810 (3.50) covers installation. The latter, Pamphlet NFPA 78-1968 ($1.25) covers lightning protection. Both pamphlets are published by and available from:

National Fire Protection Association
60 Batterymarch Street
Boston, Massachusetts 02110

Masts and metal parts should be permanently grounded using No. 10 copper or No. 8 aluminum building wire. Grounding wires should not make sharp bends and should run as straight as possible to the grounding stake or if possible to the nearest cold water pipe outside the building. Clamps should be permanent and secure. Do not bury aluminum wire in ground. Grounding stakes should be ¾" I.D. galvanized pipe or equivalent at least 18" away from house foundation. The ground rod should be driven as deeply as possible but not less than 4 feet.

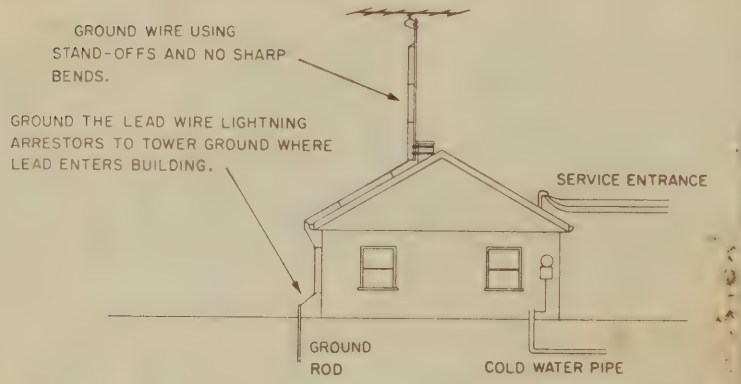


Fig. 3 — TYPICAL GROUNDING SYSTEM

UHF & COLOR RECEPTION

Special care must be exercised when installing UHF or color TV antenna lead-ins. It is recommended that shielded twin lead or coaxial lead in wire be used for UHF and color. Follow the manufacturers recommendations for matching the impedance of the lead-in wire to the TV set and to the antenna.

If ordinary 300 ohms TV lead-in wire is used for UHF or color, special care must be exercised to avoid grounding out the signal or changing the phase relation of the color signal. Avoid running the lead-in close to building or anything metal. Twist the lead-in to minimize ghosts. You may have to experiment to find the best installation method and location.

CIRCUIT

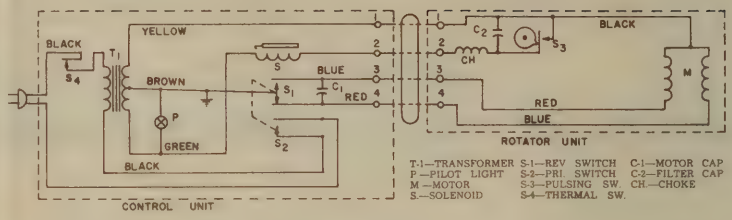


Fig. 4 — SCHEMATIC

OPERATION

Move the dial knob until the knob marking indicates the desired direction. The red pointer will now show the position of the antenna as it is moving. It is desirable to have the red pointer come to a stop before reversing direction.

When turning the knob thru an angle greater than 330° allow the unit to pulse a few times before completing the turn. Do not force the knob when the end of rotation is reached.

(A) IMPORTANT — IF LIGHTS REMAIN ON AFTER PULSING HAS STOPPED it indicates [with the exception noted in (B)] that the ROTOR and control box are not synchronized with each other and the motor is stalled. Do not allow this condiction to continue because the temperature of the motor is rising unnecessarily. Correct this condition by synchronizing per instructions under paragraph on "Synchronization", or on the underside of the control box.

(B) IMPORTANT — IF PULSING SOUND IS NOT EVIDENT WHEN YOU TURN THE KNOB, either to the right or left, it indicates that the thermoswitch has come into play. This protective device in the transformer automatically shuts off the power to the ROTOR unit when the rotator has been operated continuously for too long a period of time (usually 10 to 15 minutes) or when the ROTOR and control box have been allowed to remain out of synchronization with each other with the power on as mentioned above. To REMEDY, line the knob up with the red pointer, and allow the rotator to rest until the temperature drops. This will take about 5 minutes. The thermoswitch will then close and the rotator will again be operative.

Test for synchronization by following the instructions for synchronizing.

To replace dial light, type No. 47, in the control unit, remove the four cover screws and lift cover from chassis.

WARRANTY

CORNELL-DUBILIER ELECTRONICS warrants each new CORNELL-DUBILIER ROTOR to be free from defects in material arising from normal usage. Its obligation under this warranty is limited to replacing, or at its option repairing the rotor which, after regular installation and under normal usage and service, shall be returned within **ONE (1) YEAR** from date of original consumer purchase of the rotor to **Cornell-Dubilier Electronics, Rotor Service Dept., 118 E. Jones St., Fuquay-Varina, N. C. 27526**, together with satisfactory evidence of such purchase, and which shall be found to have been thus defective in accordance with the policies established by CORNELL-DUBILIER ELECTRONICS.

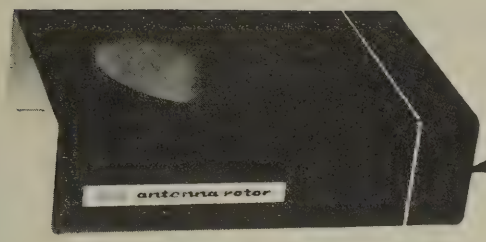
The obligation of CORNELL-DUBILIER ELECTRONICS does not include either the making or the furnishing of any labor in connection with the installation of such repaired or replacement rotor, nor does it include responsibility for any transportation expense.

CONDITIONS AND EXCLUSIONS

This warranty is expressly in lieu of all other agreements and warranties, expressed or implied, and CORNELL-DUBILIER ELECTRONICS does not authorize any person to assume for it the obligation contained in this warranty and neither assumes nor authorizes any representative or other person to assume for it any other liability in connection with such CORNELL-DUILIER Rotor.

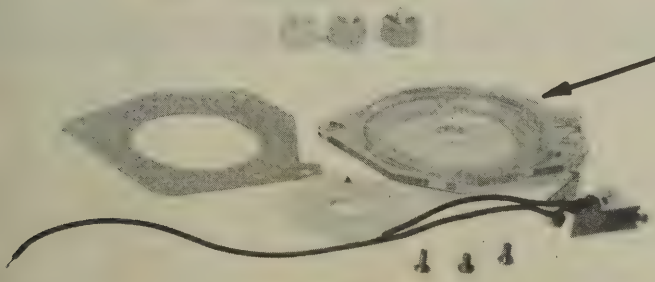
The warranty herein extends only to the original consumer and is not assignable or transferable, and shall not apply to any rotor which has been subject to alteration, misuse, negligence or accident.

CORNELL-DUBILIER ELECTRONICS
118 E. Jones Street
Fuquay-Varina, N. C. 27526



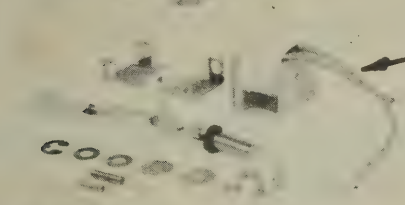
50065-10 **CONTROL BOX ASSEMBLY COMPLETE** $24.00

50580-10 **COVER KIT AR-22R/AR-10** 3.30
COVER & RECESS BUMPERS (4)

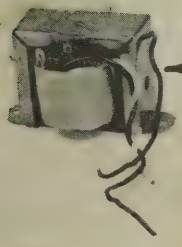


50581-10 **DIAL FACE KIT** 2.00
DIAL FACE, LIGHT SHIELD OVERLAY, METAL LIGHT SHIELD, LIGHT SOCKET, LIGHT BULB #47, SCREWS AND INDICATOR PLATE

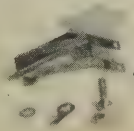
50433-10 **GEAR SPRING & INS. DISC. ASSEMBLY** 4.20
GEAR SPRING AND INS. DISC. ASSEMBLY, VINYL SLEEVING, RET. RING, KNOB ASSEMBLY, LOST MOTION LEVER AND SPRING WASHER



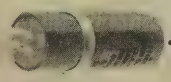
50584-10 **SOLENOID & CONNECTING BAR KIT** 2.30
COIL ASS'Y, PAWL ARM & CONNECTING BAR ASS'Y, L.H. PAWL, R.H. PAWL, PAWL SPRING, RET. RING, LEVER SPRING, ESCAPE WHEEL, FLAT WASHER, SCREWS, HEX NUTS, & FLAT WASHERS



50436-10 **TRANSFORMER, AR-22R/AR-10** 5.50

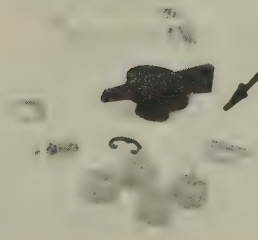


50582-10 **INSULATOR BLOCK KIT** .60
INSULATOR BLOCK & CONTACTS, HEX NUT, SCREW, GROUND LUG, & LOCK WASHER



50040-10 **CAPACITOR, ELECTROLYTIC** 1.65

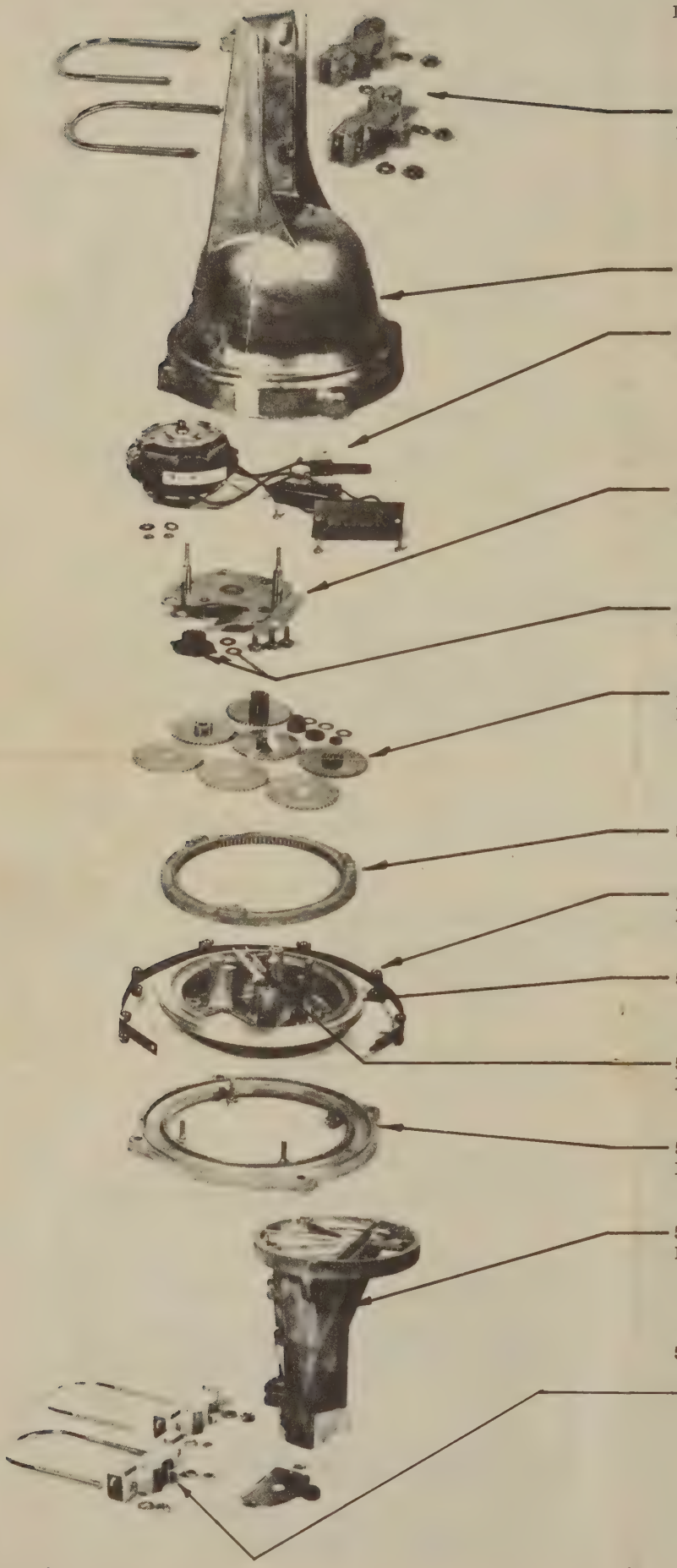
50586-10 **CHASSIS KIT AR-22R/AR-10** 3.70
CHASSIS KIT, BOTTOM COVER & SCREW



50647-10 **COMMON REPLACEMENT PARTS KIT** 1.10
RECESS BUMPERS (4), KNOB ASSEMBLY, LAMP, SPRING WASHER BOWED, PAWL SPRING, LEVER SPRING & RET. RING

AR-22R/AR-10 CONTROL BOX

ORDER PARTS USING COMPLETE NUMBER & DESCRIPTION



50429-10 **ROTATOR ASSEMBLY, COMPLETE** $34.95
Includes LOWER MAST SUPPORT & HARDWARE

50425-10 **MOUNTING HARDWARE KIT** 3.60
Includes
- 4 U-BOLTS
- 8 NUTS & LOCKWASHERS
- 4 MAST CLAMPS
- 4 LOWER MAST SUPPORT SCREWS & HARDWARE

50304-10 **UPPER MAST SUPPORT** 6.10

50419-10 **MOTOR ASSEMBLY KIT** 11.25
Includes MOTOR & PINION, CHOKE COIL, PULSE SWITCH ASSEMBLY, TERMINAL BOARD ASSEMBLY, CAPACITOR, WIRING, SCREWS, MOTOR MOUNT NUTS & LOCKWASHERS

50420-10 **MOTOR MOUNT PLATE KIT** 1.80
Includes MOTOR MOUNT PLATE & STUDS, 3 MOUNTING SCREWS, WIRING WRAP LUG & WASHER

50421-10 **CAM GEAR KIT** .70
Includes CAM GEAR, WASHER & COTTER

50422-10 **SPUR GEAR KIT** 3.00
Includes
- 3 ASSEM'D GEARS (SHT. PINION) UPPER 3
- 1 ASSEM'D GEAR (LG. PINION) LOWER L.
- 3 STACKED SPUR GEARS (LOWER R.)
- 5 SPACERS & WASHERS

50313-10 **RING GEAR** 1.40

50427-10 **BEARING STRAP ASSEMBLY** 1.60
Includes 12 BALL BEARINGS

50370-10 **BASE INCLUDING POSTS** 4.25
(Does Not Include Stop Below)

50423-10 **STOP ARM KIT** .60
Includes STOP & SPRING WASHER

50424-10 **BEARING RACE KIT** 2.25
Includes RACE & 4 MOUNTING SCREWS

50349-10 **MAST SUPPORT KIT** 3.70
Includes LOWER MAST SUPPORT, INSPECTION PLATE & GROMMET, 2 MOUNTING SCREWS FOR INSPECTION PLATE

50428-10 **GREASE FOR ONE ASSEMBLY** .35

HDWE. INCLUDED IN 50425-10 KIT

AR-22R ROTATOR

ORDER PARTS USING COMPLETE NUMBER & DESCRIPTION.

OWNER'S MANUAL

CORNELL-DUBILIER ELECTRONICS

MODEL AR-22R

AUTOMATIC ANTENNA ROTOR SYSTEM

GENERAL

Model AR-22R Antenna Rotor is designed to support and rotate the largest television antennas. The rotor will support stacked arrays and deep fringe area antennas. AR-22R is **not** intended for large Ham beams. Large Ham beams may present a sufficiently high wind resistance to rotate the antenna without being energized. This will have the effect of changing the AR-22R synchronization. For very windy areas or large beams, the CDE TR-44 or HAM-M rotors are recommended.

The AR-22R is rated to support a dead vertical weight of 150 pounds, has 500 inch pounds of motor stall torque and resists an overturning moment of approximately 4000 inch pounds without guying. The control box will control to within 6° accuracy. The rotor is lubricated for long life and is suitable to approximately —15°F. The clicking sound when rotating is normal.

INSTALLATION

Prior to mounting the rotator on the mast, it is well to check the operation of both rotator and control box wired for each of the 4 connections. CAUTION — BEFORE OPERATING UNIT READ LABEL ON BOTTOM OF CHASSIS. Model AR-22R operates from 115 VAC 60 cycle.

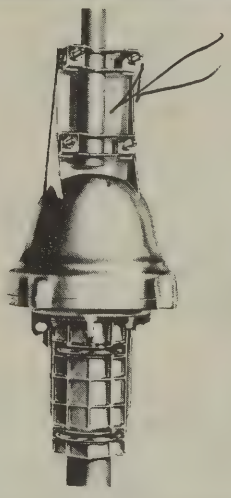
The rotator unit is shipped from the factory set at the end of rotation in full "NORTH" counter-clockwise position (looking down at top of rotor). The unit should be checked using all the wire to be used in the installation. The wire should be according to the recommended wire sizes.

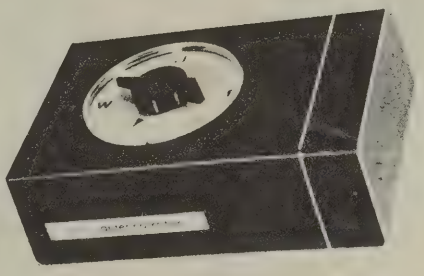
Note that the rotor mast clamps are reversible. Turning them allows clamping to large diameter (up to 2") or small diameter (down to 7/8") masts. The lower mast support may be removed from the rotor base plate so that the rotator without the lower mast support may be mounted in a tower.

Standard four-wire conductor cable is available at any electronics supply houses. Be sure to use the recommended sizes (gauges).

The lower mast support casting is shipped unmounted; feed the cable through the rubber grommet in the terminal cover plate and strip each conductor end. Connect as shown in Figure 1. Then mount the lower mast support casting to the Rotor base with four hex head bolts and lock-washers, tighten them securely.

To relieve strain on the antenna lead-in cable, standoff insulators should be mounted on the mast as follows: With the Rotor in "end" position, mount a standoff insulator directly above upper mast support and another immediately below lower mast support as shown. The standoffs should be 180° apart. Dress antenna down-lead through the standoffs, allowing sufficient slack for complete rotation. See Figure 2.





USE THE FOLLOWING WIRE SIZES:

Wire Gauge	Max. No. of Feet
22	100
20	150
18	220
16	350
14	550

GUYING

Two guy wire lugs are provided on the lower mast support casting for guying purposes. The use of standard 3/16" or 1/4" guy thimbles with adequate size wires, using turnbuckle adjustments, is recommended. Care should be taken not to tighten guy wires excessively. The installation should have a slight freedom of movement to prevent storm damage.

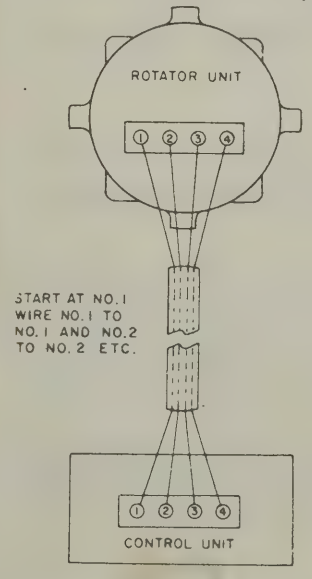


Fig. 1

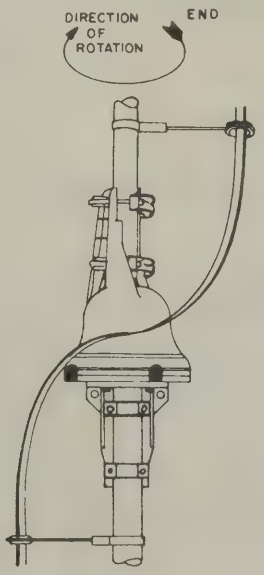


Fig. 2

The AR-22R control box is electrically identical to the previous model AR-22 and is fully interchangeable with previously manufactured AR-22 rotors.

CDE Rotor System AR-22R

SYCHRONIZATION

1. Synchronize the Rotor unit with the control box unit in 2 steps as follows:

1. Turn the knob to the extreme **counter-clockwise** position — do not force. If the lights remain on after pulsing stops, trip the synchronization lever found on the bottom of chassis until they go out.

2. Now turn the knob to the extreme **clockwise** position. If the lights remain on after pulsing stops trip the lever until they go out. The units are now synchronized.

ELECTRICAL AND LIGHTNING PROTECTION

Radio and television equipment installation practices are covered by the National Electrical Code. Two pamphlets are published, one concerning the electrical code, the other lightning protection. The former, Pamphlet NFPA 70-1971, Article 810 (3.50) covers installation. The latter, Pamphlet NFPA 78-1968 ($1.25) covers lightning protection. Both pamphlets are published by and available from:

National Fire Protection Association
60 Batterymarch Street
Boston, Massachusetts 02110

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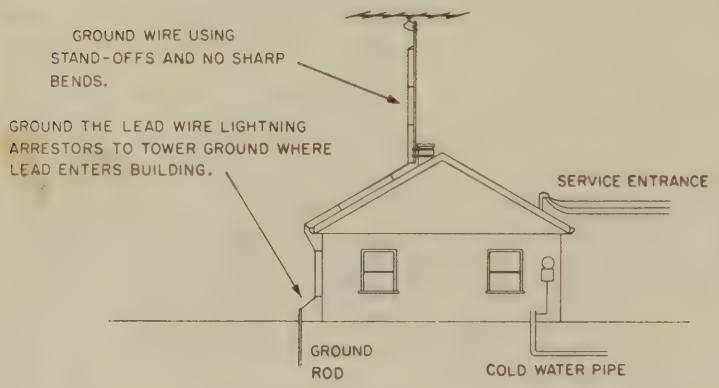

Fig. 3 — TYPICAL GROUNDING SYSTEM

UHF & COLOR RECEPTION

Special care must be exercised when installing UHF or color TV antenna lead-ins. It is recommended that shielded twin lead or coaxial lead in wire be used for UHF and color. Follow the manufacturers recommendations for matching the impedance of the lead-in wire to the TV set and to the antenna.

If ordinary 300 ohms TV lead-in wire is used for UHF or color, special care must be exercised to avoid grounding out the signal or changing the phase relation of the color signal. Avoid running the lead-in close to building or anything metal. Twist the lead-in to minimize ghosts. You may have to experiment to find the best installation method and location.

CIRCUIT

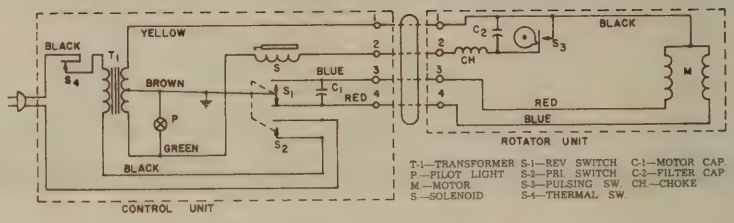

Fig. 4 — SCHEMATIC

OPERATION

Move the dial knob until the knob marking indicates the desired direction. The red pointer will now show the position of the antenna as it is moving. It is desirable to have the red pointer come to a stop before reversing direction.

When turning the knob thru an angle greater than 330° allow the unit to pulse a few times before completing the turn. Do not force the knob when the end of rotation is reached.

(A) IMPORTANT — IF LIGHTS REMAIN ON AFTER PULSING HAS STOPPED it indicates [with the exception noted in (B)] that the ROTOR and control box are not synchronized with each other and the motor is stalled. Do not allow this condiction to continue because the temperature of the motor is rising unnecessarily. Correct this condition by synchronizing per instructions under paragraph on "Synchronization", or on the underside of the control box.

(B) IMPORTANT — IF PULSING SOUND IS NOT EVIDENT WHEN YOU TURN THE KNOB, either to the right or left, it indicates that the thermoswitch has come into play. This protective device in the transformer automatically shuts off the power to the ROTOR unit when the rotator has been operated continuously for too long a period of time (usually 10 to 15 minutes) or when the ROTOR and control box have been allowed to remain out of synchronization with each other with the power on as mentioned above. To REMEDY, line the knob up with the red pointer, and allow the rotator to rest until the temperature drops. This will take about 5 minutes. The thermoswitch will then close and the rotator will again be operative.

Test for synchronization by following the instructions for synchronizing.

To replace dial light, type No. 47, in the control unit, remove the four cover screws and lift cover from chassis.

WARRANTY

CORNELL-DUBILIER ELECTRONICS warrants each new CORNELL-DUBILIER ROTOR to be free from defects in material arising from normal usage. Its obligation under this warranty is limited to replacing, or at its option repairing the rotor which, after regular installation and under normal usage and service, shall be returned within **ONE (1) YEAR** from date of original consumer purchase of the rotor to **Cornell-Dubilier Electronics, Rotor Service Dept., 118 E. Jones St., Fuquay-Varina, N. C. 27526,** together with satisfactory evidence of such purchase, and which shall be found to have been thus defective in accordance with the policies established by CORNELL-DUBILIER ELECTRONICS.

The obligation of CORNELL-DUBILIER ELECTRONICS does not include either the making or the furnishing of any labor in connection with the installation of such repaired or replacement rotor, nor does it include responsibility for any transportation expense.

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The warranty herein extends only to the original consumer and is not assignable or transferable, and shall not apply to any rotor which has been subject to alteration, misuse, negligence or accident.

CORNELL-DUBILIER ELECTRONICS
118 E. Jones Street
Fuquay-Varina, N. C. 27526

NOTICE TO SERVICEMAN: Leave this instruction sheet with the Customer. It contains his operating instructions.

Parts and Service can be obtained through your local dealer, or by writing to Cornell-Dubilier Electronics, Rotor Parts Department, 118 E. Jones Street, Fuquay-Varina, North Carolina 27526.

50065-10 **CONTROL BOX ASSEMBLY COMPLETE** $24.00

50580-10 **COVER KIT AR-22R/AR-10** 3.30

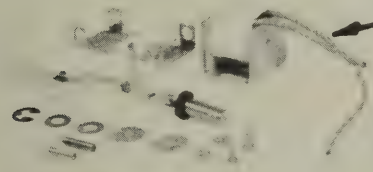
COVER & RECESS BUMPERS (4)

50581-10 **DIAL FACE KIT** 2.00

DIAL FACE, LIGHT SHIELD OVERLAY, METAL LIGHT SHIELD, LIGHT SOCKET, LIGHT BULB #47, SCREWS AND INDICATOR PLATE

50433-10 **GEAR SPRING & INS. DISC. ASSEMBLY** 4.20

GEAR SPRING AND INS. DISC. ASSEMBLY, VINYL SLEEVING, RET. RING, KNOB ASSEMBLY, LOST MOTION LEVER AND SPRING WASHER



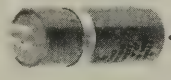
50584-10 **SOLENOID & CONNECTING BAR KIT** 2.30

COIL ASS'Y, PAWL ARM & CONNECTING BAR ASS'Y, L.H. PAWL, R.H. PAWL, PAWL SPRING, RET. RING, LEVER SPRING, ESCAPE WHEEL, FLAT WASHER, SCREWS, HEX NUTS, & FLAT WASHERS

50436-10 **TRANSFORMER, AR-22R/AR-10** 5.50

50582-10 **INSULATOR BLOCK KIT** .60

INSULATOR BLOCK & CONTACTS, HEX NUT, SCREW, GROUND LUG, & LOCK WASHER



50040-10 **CAPACITOR, ELECTROLYTIC** 1.65

50586-10 **CHASSIS KIT AR-22R/AR-10** 3.70

CHASSIS KIT, BOTTOM COVER & SCREW

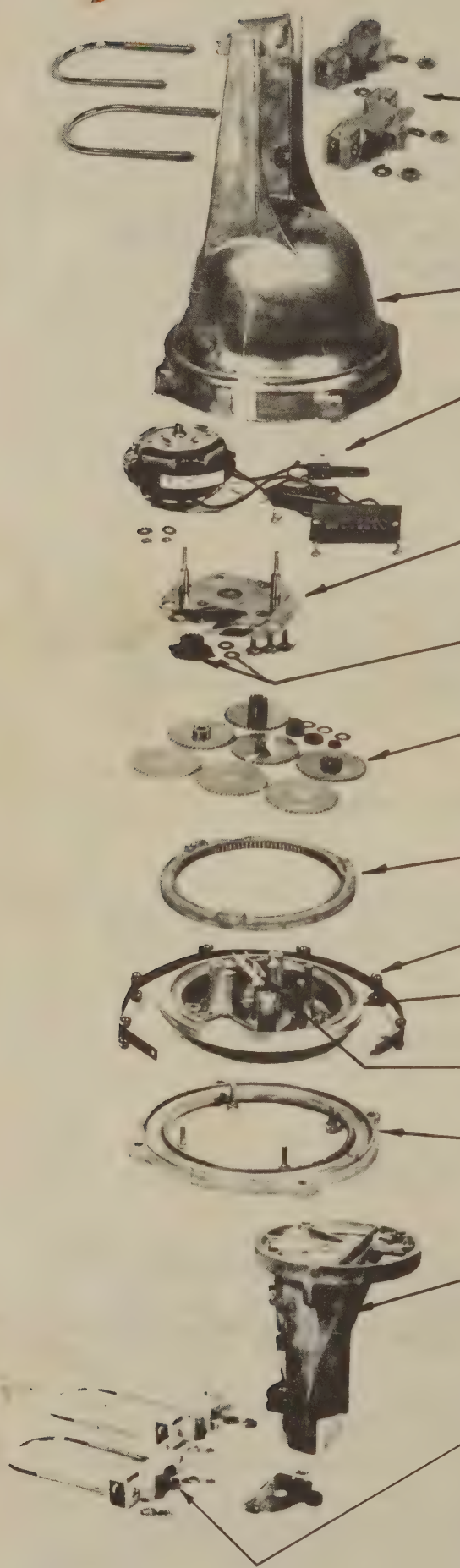
50647-10 **COMMON REPLACEMENT PARTS KIT** 1.10

RECESS BUMPERS (4), KNOB ASSEMBLY, LAMP, SPRING WASHER BOWED, PAWL SPRING, LEVER SPRING & RET. RING

AR-10/AR-20/AR-22R CONTROL BOX

ORDER PARTS USING COMPLETE NUMBER & DESCRIPTION

To order parts, remit check or money order for total parts cost plus $.50 for postage and handling to: Cornell-Dubilier Electronics, Department "C", 118 E. Jones Street, Fuquay-Varina, N. C. 27526



50429-10 **ROTATOR ASSEMBLY, COMPLETE** $34.95
Includes LOWER MAST SUPPORT & HARDWARE

50425-10 **MOUNTING HARDWARE KIT** 3.60
Includes
- 4 U-BOLTS
- 8 NUTS & LOCKWASHERS
- 4 MAST CLAMPS
- 4 LOWER MAST SUPPORT SCREWS & HARDWARE

50304-10 **UPPER MAST SUPPORT** 6.10

50419-10 **MOTOR ASSEMBLY KIT** 11.25
Includes MOTOR & PINION, CHOKE COIL, PULSE SWITCH ASSEMBLY, TERMINAL BOARD ASSEMBLY, CAPACITOR, WIRING, SCREWS, MOTOR MOUNT NUTS & LOCKWASHERS

50420-10 **MOTOR MOUNT PLATE KIT** 1.80
Includes MOTOR MOUNT PLATE & STUDS, 3 MOUNTING SCREWS, WIRING WRAP LUG & WASHER

50421-10 **CAM GEAR KIT** .70
Includes CAM GEAR, WASHER & COTTER

50422-10 **SPUR GEAR KIT** 3.00
Includes
- 3 ASSEM'D GEARS (SHT. PINION) UPPER 3
- 1 ASSEM'D GEAR (LG. PINION) LOWER L.
- 3 STACKED SPUR GEARS (LOWER R.)
- 5 SPACERS & WASHERS

50313-10 **RING GEAR** 1.40

50427-10 **BEARING STRAP ASSEMBLY** 1.60
Includes 12 BALL BEARINGS

50370-10 **BASE INCLUDING POSTS** 4.25
(Does Not Include Stop Below)

50423-10 **STOP ARM KIT** .60
Includes STOP & SPRING WASHER

50424-10 **BEARING RACE KIT** 2.25
Includes RACE & 4 MOUNTING SCREWS

50349-10 **MAST SUPPORT KIT** 3.70
Includes LOWER MAST SUPPORT, INSPECTION PLATE & GROMMET, 2 MOUNTING SCREWS FOR INSPECTION PLATE

50428-10 **GREASE FOR ONE ASSEMBLY** .35

HDWE. INCLUDED IN 50425-10 KIT

AR-22R ROTATOR

ORDER PARTS USING COMPLETE NUMBER & DESCRIPTION

To order parts, remit check or money order for total parts cost plus $.50 for postage and handling to: Cornell-Dubilier Electronics, Department "C", 118 E. Jones Street, Fuquay-Varina, N. C. 27526

OWNER'S MANUAL

CORNELL-DUBILIER ELECTRONICS

MODEL AR-22R

AUTOMATIC ANTENNA ROTOR SYSTEM

GENERAL

Model AR-22R Antenna Rotor is designed to support and rotate the largest television antennas. The rotor will support stacked arrays and deep fringe area antennas. AR-22R is **not** intended for large Ham beams. Large Ham beams may present a sufficiently high wind resistance to rotate the antenna without being energized. This will have the effect of changing the AR-22R synchronization. For very windy areas or large beams, the CDE TR-44 or HAM-M rotors are recommended.

The AR-22R is rated to support a dead vertical weight of 150 pounds, has 500 inch pounds of motor stall torque and resists an overturning moment of approximately 4000 inch pounds without guying. The control box will control to within 6° accuracy. The rotor is lubricated for long life and is suitable to approximately —15°F. The clicking sound when rotating is normal.

INSTALLATION

Prior to mounting the rotator on the mast, it is well to check the operation of both rotator and control box wired for each of the 4 connections. CAUTION — BEFORE OPERATING UNIT READ LABEL ON BOTTOM OF CHASSIS. Model AR-22R operates from 115 VAC 60 cycle.

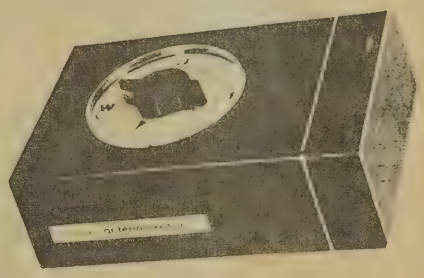
The rotator unit is shipped from the factory set at the end of rotation in full "NORTH" counter-clockwise position (looking down at top of rotor). The unit should be checked using all the wire to be used in the installation. The wire should be according to the recommended wire sizes.

Note that the rotor mast clamps are reversible. Turning them allows clamping to large diameter (up to 2") or small diameter (down to 7/8") masts. The lower mast support may be removed from the rotor base plate so that the rotator without the lower mast support may be mounted in a tower.

Standard four-wire conductor cable is available at any electronics supply houses. Be sure to use the recommended sizes (gauges).

The lower mast support casting is shipped unmounted; feed the cable through the rubber grommet in the terminal cover plate and strip each conductor end. Connect as shown in Figure 1. Then mount the lower mast support casting to the Rotor base with four hex head bolts and lock-washers, tighten them securely.

To relieve strain on the antenna lead-in cable, standoff insulators should be mounted on the mast as follows: With the Rotor in "end" position, mount a standoff insulator directly above upper mast support and another immediately below lower mast support as shown. The standoffs should be 180° apart. Dress antenna down-lead through the standoffs, allowing sufficient slack for complete rotation. See Figure 2.



USE THE FOLLOWING WIRE SIZES:

Wire Gauge	Max. No. of Feet
22	100
20	150
18	220
16	350
14	550

GUYING

Two guy wire lugs are provided on the lower mast support casting for guying purposes. The use of standard 3/16" or 1/4" guy thimbles with adequate size wires, using turnbuckle adjustments, is recommended. Care should be taken not to tighten guy wires excessively. The installation should have a slight freedom of movement to prevent storm damage.

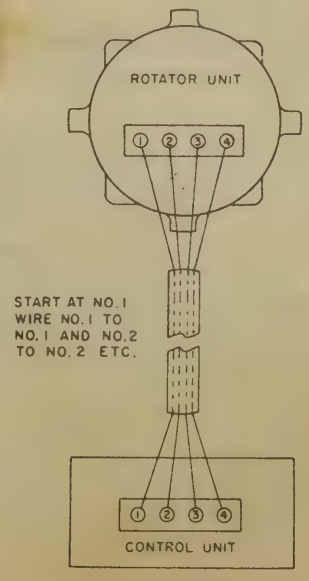


Fig. 1

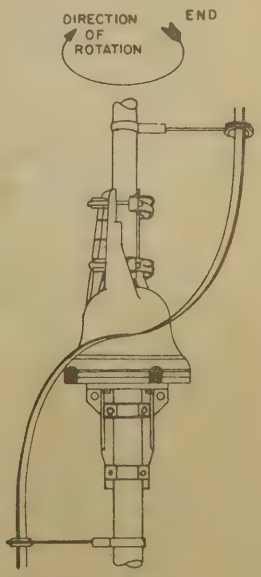


Fig. 2

The AR-22R control box is electrically identical to the previous model AR-22 and is fully interchangeable with previously manufactured AR-22 rotors.

CDE Rotor System AR-22R

SYCHRONIZATION

1. Synchronize the Rotor unit with the control box unit in 2 steps as follows:

1. Turn the knob to the extreme **counter-clockwise** position — do not force. If the lights remain on after pulsing stops, trip the synchronization lever found on the bottom of chassis until they go out.

2. Now turn the knob to the extreme **clockwise** position. If the lights remain on after pulsing stops trip the lever until they go out. The units are now synchronized.

ELECTRICAL AND LIGHTNING PROTECTION

Radio and television equipment installation practices are covered by the National Electrical Code. Two pamphlets are published, one concerning the electrical code, the other lightning protection. The former, Pamphlet NFPA 70-1971, Article 810 (3.50) covers installation. The latter, Pamphlet NFPA 78-1968 ($1.25) covers lightning protection. Both pamphlets are published by and available from:

National Fire Protection Association
60 Batterymarch Street
Boston, Massachusetts 02110

Masts and metal parts should be permanently grounded using No. 10 copper or No. 8 aluminum building wire. Grounding wires should not make sharp bends and should run as straight as possible to the grounding stake or if possible to the nearest cold water pipe outside the building. Clamps should be permanent and secure. Do not bury aluminum wire in ground. Grounding stakes should be ¾" I.D. galvanized pipe or equivalent at least 18" away from house foundation. The ground rod should be driven as deeply as possible but not less than 4 feet.

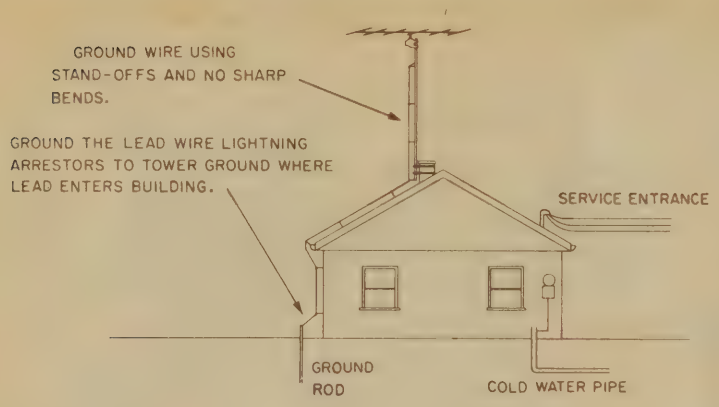


Fig. 3 — TYPICAL GROUNDING SYSTEM

UHF & COLOR RECEPTION

Special care must be exercised when installing UHF or color TV antenna lead-ins. It is recommended that shielded twin lead or coaxial lead in wire be used for UHF and color. Follow the manufacturers recommendations for matching the impedance of the lead-in wire to the TV set and to the antenna.

If ordinary 300 ohms TV lead-in wire is used for UHF or color, special care must be exercised to avoid grounding out the signal or changing the phase relation of the color signal. Avoid running the lead-in close to building or anything metal. Twist the lead-in to minimize ghosts. You may have to experiment to find the best installation method and location.

CIRCUIT

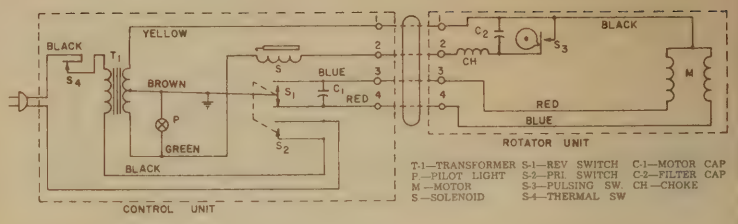


Fig. 4 — SCHEMATIC

OPERATION

Move the dial knob until the knob marking indicates the desired direction. The red pointer will now show the position of the antenna as it is moving. It is desirable to have the red pointer come to a stop before reversing direction.

When turning the knob thru an angle greater than 330° allow the unit to pulse a few times before completing the turn. Do not force the knob when the end of rotation is reached.

(A) IMPORTANT — IF LIGHTS REMAIN ON AFTER PULSING HAS STOPPED it indicates [with the exception noted in (B)] that the ROTOR and control box are not synchronized with each other and the motor is stalled. Do not allow this condiction to continue because the temperature of the motor is rising unnecessarily. Correct this condition by synchronizing per instructions under paragraph on "Synchronization", or on the underside of the control box.

(B) IMPORTANT — IF PULSING SOUND IS NOT EVIDENT WHEN YOU TURN THE KNOB, either to the right or left, it indicates that the thermoswitch has come into play. This protective device in the transformer automatically shuts off the power to the ROTOR unit when the rotator has been operated continuously for too long a period of time (usually 10 to 15 minutes) or when the ROTOR and control box have been allowed to remain out of synchronization with each other with the power on as mentioned above. To REMEDY, line the knob up with the red pointer, and allow the rotator to rest until the temperature drops. This will take about 5 minutes. The thermoswitch will then close and the rotator will again be operative.

Test for synchronization by following the instructions for synchronizing.

To replace dial light, type No. 47, in the control unit, remove the four cover screws and lift cover from chassis.

WARRANTY

CORNELL-DUBILIER ELECTRONICS warrants each new CORNELL-DUBILIER ROTOR to be free from defects in material arising from normal usage. Its obligation under this warranty is limited to replacing, or at its option repairing the rotor which, after regular installation and under normal usage and service, shall be returned within **ONE (1) YEAR** from date of original consumer purchase of the rotor to **Cornell-Dubilier Electronics, Rotor Service Dept., 118 E. Jones St., Fuquay-Varina, N. C. 27526,** together with satisfactory evidence of such purchase, and which shall be found to have been thus defective in accordance with the policies established by CORNELL-DUBILIER ELECTRONICS.

The obligation of CORNELL-DUBILIER ELECTRONICS does not include either the making or the furnishing of any labor in connection with the installation of such repaired or replacement rotor, nor does it include responsibility for any transportation expense.

CONDITIONS AND EXCLUSIONS

This warranty is expressly in lieu of all other agreements and warranties, expressed or implied, and CORNELL-DUBILIER ELECTRONICS does not authorize any person to assume for it the obligation contained in this warranty and neither assumes nor authorizes any representative or other person to assume for it any other liability in connection with such CORNELL-DUILIER Rotor.

The warranty herein extends only to the original consumer and is not assignable or transferable, and shall not apply to any rotor which has been subject to alteration, misuse, negligence or accident.

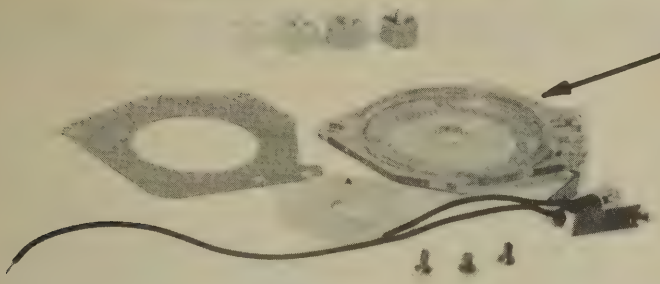
CORNELL-DUBILIER ELECTRONICS
118 E. Jones Street
Fuquay-Varina, N. C. 27526

NOTICE TO SERVICEMAN: Leave this instruction sheet with the Customer. It contains his operating instructions.

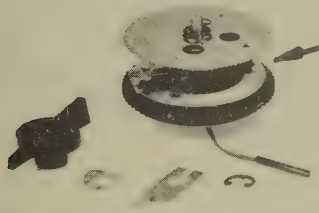
Parts and Service can be obtained through your local dealer, or by writing to Cornell-Dubilier Electronics, Rotor Parts Department, 118 E. Jones Street, Fuquay-Varina, North Carolina 27526.

50065-10 **CONTROL BOX ASSEMBLY COMPLETE**
REPLACED BY 51235 - 10

50580-10 **COVER KIT AR-22R/AR-10**
COVER & RECESS BUMPERS (4)

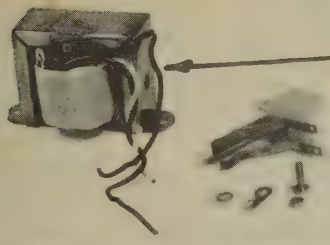


50581-10 **DIAL FACE KIT**
DIAL FACE, LIGHT SHIELD OVERLAY, METAL LIGHT SHIELD, LIGHT SOCKET, LIGHT BULB #47, SCREWS AND INDICATOR PLATE



50433-10 **GEAR SPRING & INS. DISC. ASSEMBLY**
GEAR SPRING AND INS. DISC. ASSEMBLY, VINYL SLEEVING, RET. RING, KNOB ASSEMBLY, LOST MOTION LEVER AND SPRING WASHER

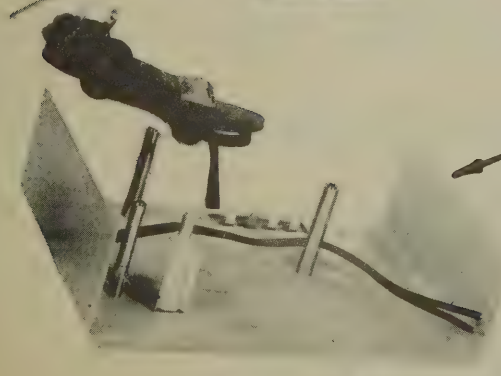
50584-10 **SOLENOID & CONNECTING BAR KIT**
COIL ASS'Y, PAWL ARM & CONNECTING BAR ASS'Y, L.H. PAWL, R.H. PAWL, PAWL SPRING, RET. RING, LEVER SPRING, ESCAPE WHEEL, FLAT WASHER, SCREWS, HEX NUTS, & FLAT WASHERS



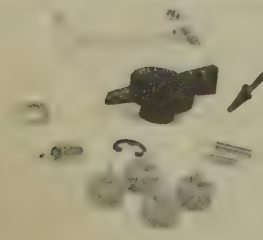
50436-10 **TRANSFORMER, AR-22R/AR-10**

50582-10 **INSULATOR BLOCK KIT**
INSULATOR BLOCK & CONTACTS, HEX NUT, SCREW, GROUND LUG, & LOCK WASHER

50040-10 **CAPACITOR, ELECTROLYTIC**
REPLACED BY 51172 - 10



50586-10 **CHASSIS KIT AR-22R/AR-10**
CHASSIS KIT, BOTTOM COVER & SCREW



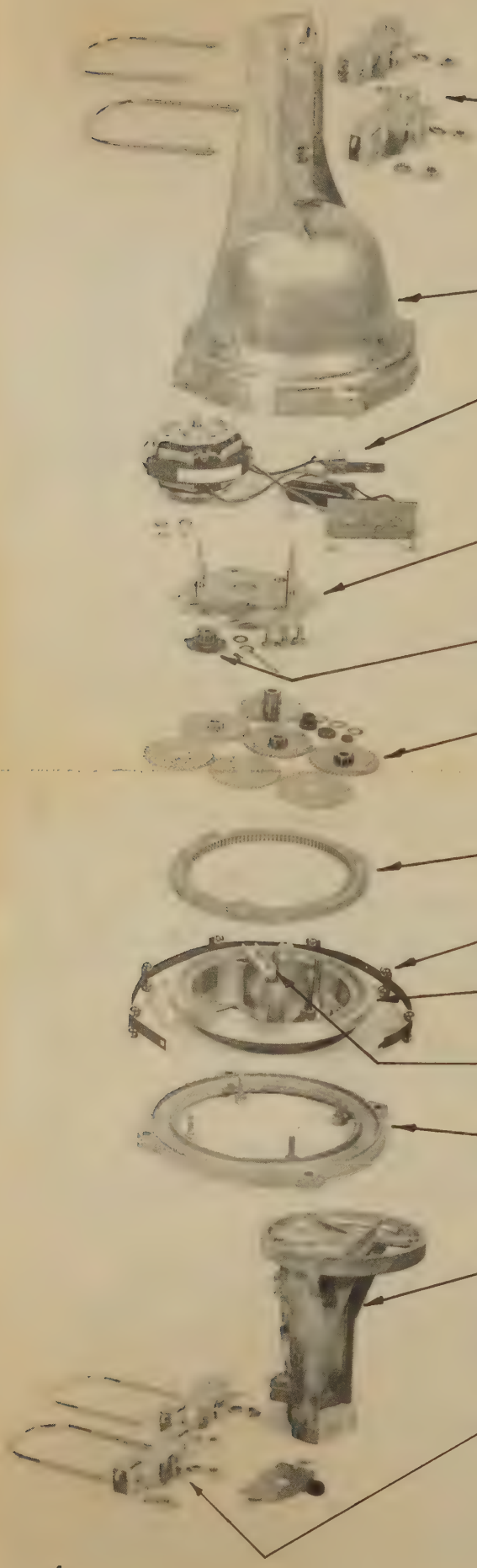
50647-10 **COMMON REPLACEMENT PARTS KIT**
RECESS BUMPERS (4), KNOB ASSEMBLY, LAMP, SPRING WASHER BOWED, PAWL SPRING, LEVER SPRING & RET. RING

AR-10/AR-20/AR-22R CONTROL BOX

ORDER PARTS USING COMPLETE NUMBER & DESCRIPTION

To order parts, remit check or money order for total parts cost plus $1.00 for postage and handling to: Cornell-Dubilier Electronics, Department "C", 118 E. Jones Street, Fuquay-Varina, N. C. 27526

WRITE FACTORY FOR PRICE AND AVAILABILITY



50429-10 **ROTATOR ASSEMBLY, COMPLETE**
Includes LOWER MAST SUPPORT & HARDWARE

50425-10 **MOUNTING HARDWARE KIT**
Includes
- 4 U-BOLTS
- 8 NUTS & LOCKWASHERS
- 4 MAST CLAMPS
- 4 LOWER MAST SUPPORT SCREWS & HARDWARE

50304-10 **UPPER MAST SUPPORT**

50419-10 **MOTOR ASSEMBLY KIT**
Includes MOTOR & PINION, CHOKE COIL, PULSE SWITCH ASSEMBLY, TERMINAL BOARD ASSEMBLY, CAPACITOR, WIRING, SCREWS, MOTOR MOUNT NUTS & LOCKWASHERS

50420-10 **MOTOR MOUNT PLATE KIT**
Includes MOTOR MOUNT PLATE & STUDS, 3 MOUNTING SCREWS, WIRING WRAP LUG & WASHER

50421-10 **CAM GEAR KIT**
Includes CAM GEAR, WASHER & COTTER

50422-10 **SPUR GEAR KIT**
Includes
- 3 ASSEM'D GEARS (SHT. PINION) UPPER 3
- 1 ASSEM'D GEAR (LG. PINION) LOWER L.
- 3 STACKED SPUR GEARS (LOWER R.)
- 5 SPACERS & WASHERS

50313-10 **RING GEAR**

50427-10 **BEARING STRAP ASSEMBLY**
Includes 12 BALL BEARINGS

50370-10 **BASE INCLUDING POSTS**
(Does Not Include Stop Below)

50423-10 **STOP ARM KIT**
Includes STOP & SPRING WASHER

50424-10 **BEARING RACE KIT**
Includes RACE & 4 MOUNTING SCREWS

50349-10 **MAST SUPPORT KIT**
Includes LOWER MAST SUPPORT, INSPECTION PLATE & GROMMET, 2 MOUNTING SCREWS FOR INSPECTION PLATE

50428-10 **GREASE FOR ONE ASSEMBLY**

HDWE. INCLUDED IN 50425-10 KIT

WRITE FACTORY FOR PRICE AND AVAILABILITY

AR-22R ROTATOR

ORDER PARTS USING COMPLETE NUMBER & DESCRIPTION

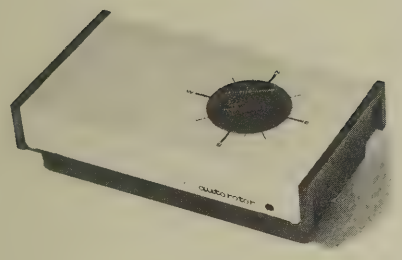
To order parts, remit check or money order for total parts cost plus $1.00 for postage and handling to: Cornell-Dubilier Electronics, Department "C", 118 E. Jones Street, Fuquay-Varina, N. C. 27526

OWNER'S MANUAL

CORNELL-DUBILIER ELECTRONICS

MODEL AR-40

SOLID STATE AUTOMATIC ANTENNA ROTOR SYSTEM



GENERAL

The Cornell - Dubilier AR - 40 is an all transistorized Television Antenna Rotor System designed to support and rotate large television antennas. This rotator will support stacked arrays and deep fringe area television antennas.

The AR - 40 is rated to support and rotate antennas with up to 1.5 square feet of wind area. The maximum side thrust, or overturning momentum, is approximately 4000 inch pounds without guying.

USE THE FOLLOWING WIRE SIZES:

AWG Wire Sizes	Max. No. of Feet
22	75
20	125
18	195
16	325
14	500

PRE-INSTALLATION

In the interest of familarization and checking the equipment, we recommend that the rotor system be set-up and checked out prior to actual installation. Please follow the recommended pre-installation check on a step-by-step basis.

1. Remove the control box, rotator unit, and mounting hardware from the packing carton.

2. Check the equipment, If there is any apparent damage or parts missing, return the complete system to your dealer for a replacement.

3. Measure out the maximum amount of 5-wire lead-in cable required for your installation. Prepare all five wires on both ends of the cable by stripping off approximately ½" of the insulation. Care must be exercised so as not to cut any of the wire strands. Twist each wire to tighten the strands. It is recommended that you solder each wire to form a solid mass.

4. With the control box and rotator on the work bench, connect the cable between the two units. Make sure wires 1, 2, 3, 4, and 5 control box are to wires 1, 2, 3, 4, and 5 on the rotator respectively.

Caution: Make sure no loose strands of wire are touching adjacent terminals or the metal case of the rotator.

5. With the rotator sitting upright and connected to the control box by the five wire lead-in cable, plug the control box power cord into a convenient 115 VAC 50/60 cycle wall socket.

6. The system is now ready for a pre-installation test.

7. Turn the directional control to "S", **momentarily press down on the control knob.** The rotator will start to turn and the indicator light on the control box will come on. When the rotator reaches "S", it will automatically stop and the light will go off. Turn the control knob on around to "N" (clockwise), momentarily press the control knob. The rotator will turn to its complete clockwise position (N). Repeat the foregiven procedure in the counter clockwise direction. Leave the system in the "N" position (complete counter-clockwise). No power is applied to any component of the AR-40 when the indicator lamp is off. There is no manual on/off switch as the unit is totally automatic. If rotor light remains on at either full clockwise or counter-clockwise North, adjust pot shaft on underside of control box until light goes off.

8. Disconnect the 115 VAC 50/60 cycle power by removing the plug from the wall socket.

9. Remove the five wire lead-in cable from the control box and the rotator. It is recommended that the wires be tagged with the terminal numbers for ease of installation.

10. The system is now ready for installation.

Do not force knob past "N".

INSTALLATION

Now that the unit has been checked and you have become familiar with its operation, installation can proceed. The most important aspect to a good quality installation is neatness and well secured connections. All wires and cables should be dressed and fixed well. Clamps and guy wires that are not tightened tend to loosen in high wind conditions which could mean that your complete antenna system will be damaged.

1. Prior to installation, lay out all the equipment and tools to be used and check everything carefully.

2. For mast mounting, typical requirements are:

   a. Antenna
   b. Rotor system
   c. Main Mast (10' per section)
   d. 3' upper mast (can be cut from a 10' section)
   e. Guy wires (min. 3 per 10' section)
   f. Mast base plate, chimney straps, etc.
   g. Guy wire tie-down eyes (one per guy wire)
   h. Five wire rotor control cable
   i. Antenna lead-in cable (300 ohm twin or coaxial)
   j. Antenna lead-in stand-off insulators (one per 4' of mast plus one for above and one for below the rotator (see plate two).

NOTICE TO SERVICEMAN: Leave this instruction sheet with the Customer. It contains his operating instructions.

Parts and Service can be obtained through your local dealer, or by writing to Cornell-Dubilier Electronics, Rotor Parts Department, 118 E. Jones Street, Fuquay-Varina, North Carolina 27526.

CDE Rotor System AR-40

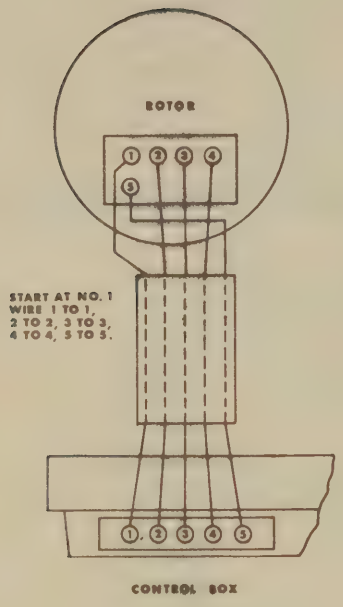


PLATE 1

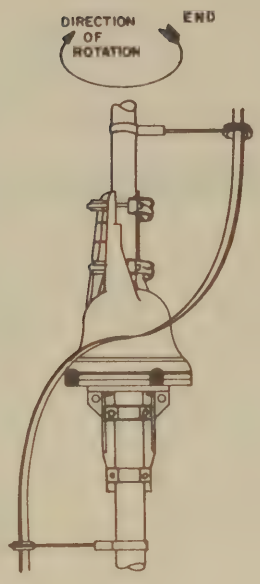


PLATE 2

k. Electrical tape

3. Mount mast to roof, chimney, Bi-pod mount, or choice.
4. Mount the rotator on the mast with hardware supplied.
5. Attach one end of the five-wire to the rotator terminals. Use the same sequence as used on the pre-installation check. The cover and grommet must be slipped over the cable prior to attaching it to the terminals on the rotator.
6. Tape the rotor control cable to the mast at points 18" to 24" apart.
7. Attach the antenna lead-in stand-off bracket 36" to 48" apart. Connect the antenna lead-in to the antenna (follow manufacturers recommendation). Run the antenna lead-in down the mast by inserting it in the insulators. Make sure you have enough slack for the 360° rotation. (The antenna rotates "N" to "E" (clockwise), therefore, slack should wrap clockwise around the mast. (See plate two.)
8. Attached the mast guy wires to the rotator or mast ring.
9. Raise the mast into position. Rotate the mast by hand, until the antenna receiving end is pointing in a northerly direction. Tighten the base clamp. Line up the mast in the vertical position and tighten and secure the guy wires.
10. Continue the antenna lead-in and five-wire control cable into the room where your T.V. set is to be located. Note: in a metal building or a mobile home, stand-off insulators should be used throughout for the antenna lead-in.
11. Connect the five-wire cable to the control box. Use the same sequence as used on the rotator. Note: make sure all connections are clean and that no wires or wire strands are touching unintended terminals.
12. Connect the antenna cable to the T.V. set.
13. Plug the control box line into the wall socket.
14. Check the rotor system operation as done in the pre-installation check.
15. The system is now ready for operation.

SERVICE

Cornell-Dubilier maintains a modern well staffed repair department for all CDE antenna rotors. If service is required, the unit should be packed securely and sent prepaid to:

Cornell-Dubilier Electronics
Rotor Service Department
118 East Jones Street
Fuquay-Varina, N. C 27526

For units that are in warranty, no charge will be made for repair. If the unit is out of warranty, the following flat rate charges apply:

Control box only	$10.00
Rotator only	$10.00
Complete unit	$15.00

A check or money order for the amount indicated above should be included. The flat rate charge includes rebuilding the unit and replacing all defective parts.

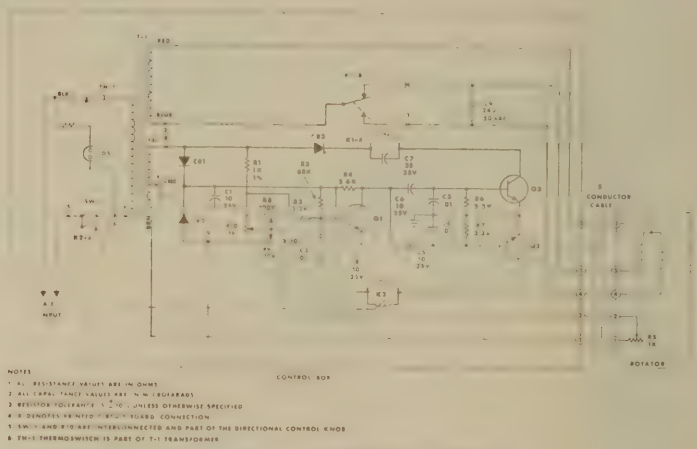


Plate 3 — SCHEMATIC

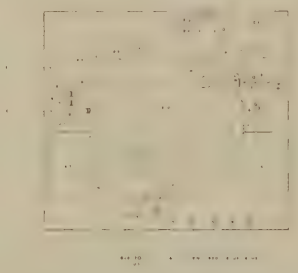


Plate 4 — PRINTED CIRCUIT BOARD ASSEMBLY

LIMITED WARRANTY

CORNELL-DUBILIER ELECTRONICS warrants each new CORNELL-DUBILIER ROTOR to be free from defect in material arising from normal usage. Its obligation under this warranty is limited to replacing, or at its option repairing the rotor which, after regular installation and under normal usage and service, shall be returned within ONE (1) YEAR from date of original consumer purchase of the rotor to Cornell-Dubilier Electronics, Rotor Service Dept., 118 E. Jones St., Fuquay-Varina, N. C. 27526, together with satisfactory evidence of such purchase, and which shall be found to have been thus defective in accordance with the policies established by CORNELL-DUBILIER ELECTRONICS.

The obligation of CORNELL-DUBILIER ELECTRONICS does not include either the making or the furnishing of any labor in connection with the installation of such repaired or replacement rotor, nor does it include responsibility for any transportation expense.

CONDITIONS AND EXCLUSIONS

This warranty is expressly in lieu of all other agreements and warranties, expressed or implied, and CORNELL-DUBILIER ELECTRONICS does not authorize any person to assume for it the obligation contained in this warranty and neither assumes nor authorizes any representative or other person to assume for it any other liability in connection with such CORNELL-DUBILIER Rotor.

The warranty herein extends only to the original consumer and is not assignable or transferable, and shall not apply to any rotor which has been subject to alternation, misuse, negligence or accident.

CORNELL-DUBILIER ELECTRONICS
118 E. Jones Street
Fuquay-Varina, N. C. 27526

TELEX COMMUNICATIONS, INC.
Divisions: HY-GAIN • MAGNECORD • TURNER®

8601 Northeast Highway 6 • Lincoln, Nebraska 68505 U S A • Telephone (402) 467 5321 • telex: Hygain Lcn a 48-4324

Dear Customer:

Telex Communications, Inc. has purchased the rotor business from Cornell-Dubilier Electronics.

All rotor service and parts orders will be handled by our Hy-Gain Electronics Division plant.

Future inquiries for parts and service should be addressed to Hy-Gain at Lincoln, Nebraska.

Rotor sales and orders will be handled through our Amateur Marketing Department in Minneapolis, Minnesota.

NOTE: Parts and Service available from:

Hy-Gain Electronics
8601 N.E. Hwy 6
Lincoln, NE 68505
Attn: Customer Service

Rotor Sales available from:

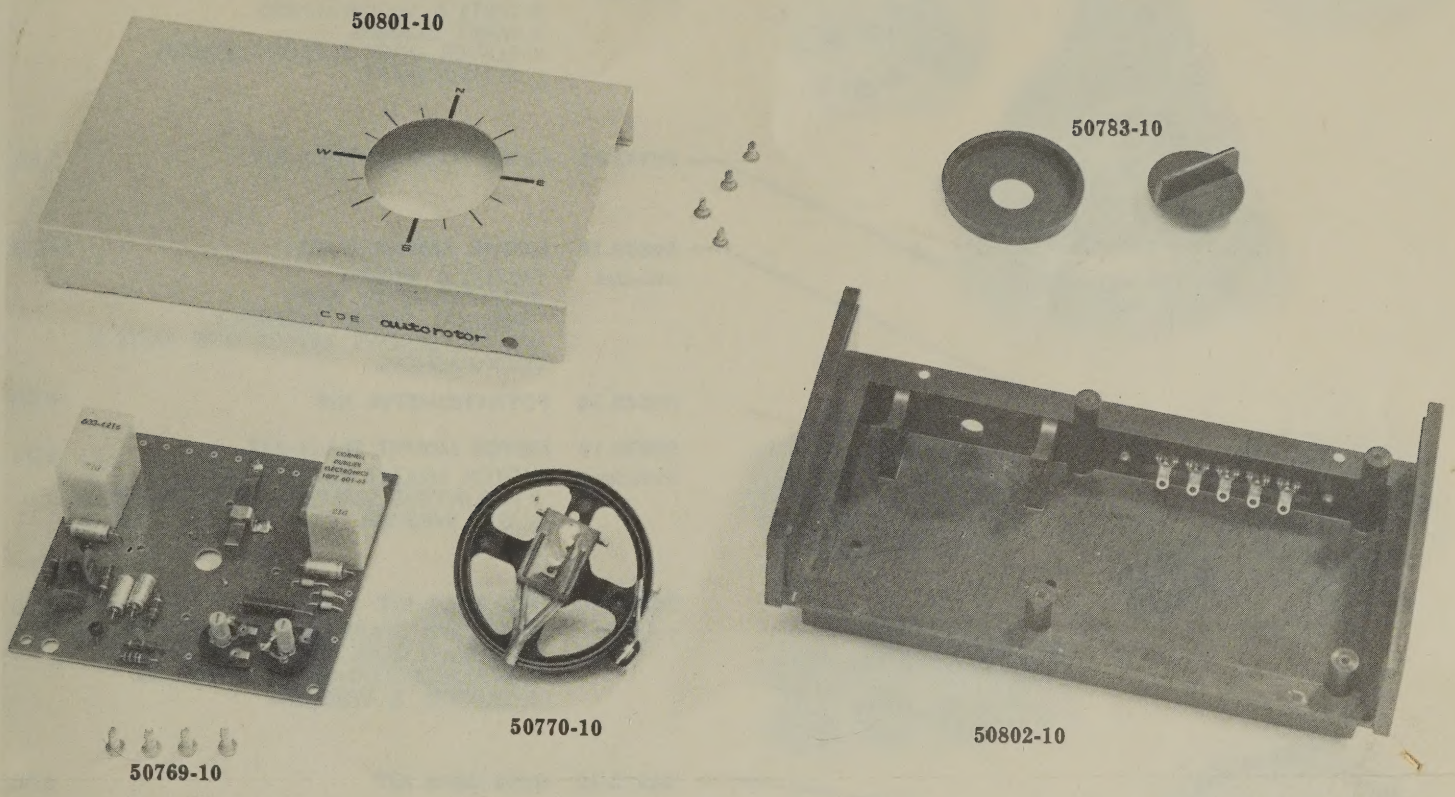
Telex Communications, Inc.
9600 Aldrich Avenue South
Minneapolis, MN 55420
Attn: Amateur Marketing Dept.

Customer Service Department

12-22-81

Europe: 22, rue de la Legion-d'Honneur • 93200 Saint-Denis - France • Telephone: 820.98.46 • telex: telcodi 63-0013

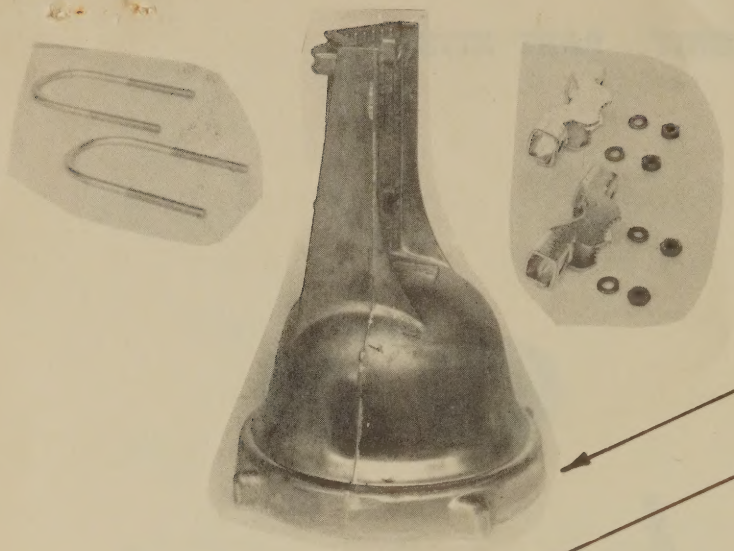
AR-30/AR-40 CONTROL UNIT - PART KITS



50796-10	**Control unit, Complete**	$32.00
50769-10	**Printed Circuit Assembly Kit**	16.00
50770-10	**Potentiometer Kit;** R-10 and Shaft Assy. (1 per kit)	6.90
50772-10	**Relay Kit:** K-2 (1 per kit)	4.80
50773-10	**Relay Kit:** K-1 (1 per kit)	5.40
50774-10	**Potentiometer Kit:** R-8 and R-9, End of Rotation (2 per kit)	1.50
50775-10	**Transistor Kit:** Q1, Q2, and Q3 (3 per Kit)	2.30
50776-10	**Diode Kit:** CR-1, CR-2 and CR-3 (3 per kit)	2.30
50777-10	**Capacitor Kit:** C-1 thru C-8 (8 per kit)	3.00
50778-10	**Motor Start Capacitor Kit:** C-9 (1 per kit)	2.50
50779-10	**Resistor Kit:** R1, R2, R3, R4, R6, and R7 (6 per kit)	1.20
50781-10	**Line Cord Kit:** 115 VAC (1 per kit)	1.20
50782-10	**Terminal Kit:** 5 terminal connector (1 per kit)	.60
50783-10	**Knob & Eschutcheon Kit** (1 per kit)	1.60
50784-10	**Transformer Kit:** 115 VAC 50/60HZ (1 per kit)	6.60
50801-10	**Cover Kit** (1 per kit)	3.60
50802-10	**Chassis Kit:** Chassis E/W Feet & Terminal Strip (1 per kit)	3.60

ORDER PARTS USING COMPLETE NUMBER & DESCRIPTION

To order parts, remit check or money order for total parts cost plus $.50 for postage and handling to: Cornell-Dubilier Electronics, Department "C", 118 E. Jones Street, Fuquay-Varina, N. C. 27526



50854-10 **ROTATOR ASSEMBLY, COMPLETE** $35.50
Includes LOWER MAST SUPPORT & HARDWARE

50425-10 **MOUNTING HARDWARE KIT** 4.30
Includes
4 U-BOLTS
8 NUTS & LOCKWASHERS
4 MAST CLAMPS
4 LOWER MAST SUPPORT SCREWS & HARDWARE

50304-10 **UPPER MAST SUPPORT KIT** 7.00

50855-10 **MOTOR ASSEMBLY KIT** 14.70
Includes
MOTOR & PINION
POTENTIOMETER ASS'Y
TERMINAL BOARD ASSEMBLY
WIRING, SCREWS, MOTOR MTG. NUTS & LOCKWASHERS.

50640-10 **POTENTIOMETER KIT** 8.00

50420-10 **MOTOR MOUNT PLATE KIT** 2.20
Includes
MOTOR MOUNT PLATE & STUDS,
3 MOUNTING SCREWS, WIRING WRAP LUG & WASHER

50422-10 **SPUR GEAR KIT** 3.60
Includes
3 ASSEM'D GEARS (SHT. PINION) UPPER 3
1 ASSEM'D GEAR (LG. PINION) UPPER L.
3 STACKED SPUR GEARS (LOWER R.)
5 SPACERS & WASHERS

50313-10 **RING GEAR KIT** 2.50

50427-10 **BEARING STRAP ASSEMBLY KIT** 2.00
Includes
12 BALL BEARINGS

50370-10 **BASE KIT INCLUDES POSTS** 5.10
(Does Not Include Stop Below)

50423-10 **STOP ARM KIT** 1.00
Includes
STOP & SPRING WASHER

50424-10 **BEARING RACE KIT** 3.60
Includes
RACE & 4 MOUNTING SCREWS

50349-10 **MAST SUPPORT KIT** 4.50
Includes
LOWER MAST SUPPORT, INSPECTION PLATE & GROMMET, 2 MOUNTING SCREWS FOR INSPECTION PLATE

50428-10 **GREASE FOR ONE ASSEMBLY** .50

HDWE. INCLUDED IN 50425-10 KIT

AR-40 ROTATOR

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